

BUILD A BUG FINDER

www.gernsback.com

JULY 1999

Electronics NOW

The DJ MixMaster

You'll be the life of any party when you build this professional-grade DJ mixing board

How To Succeed In Soldering

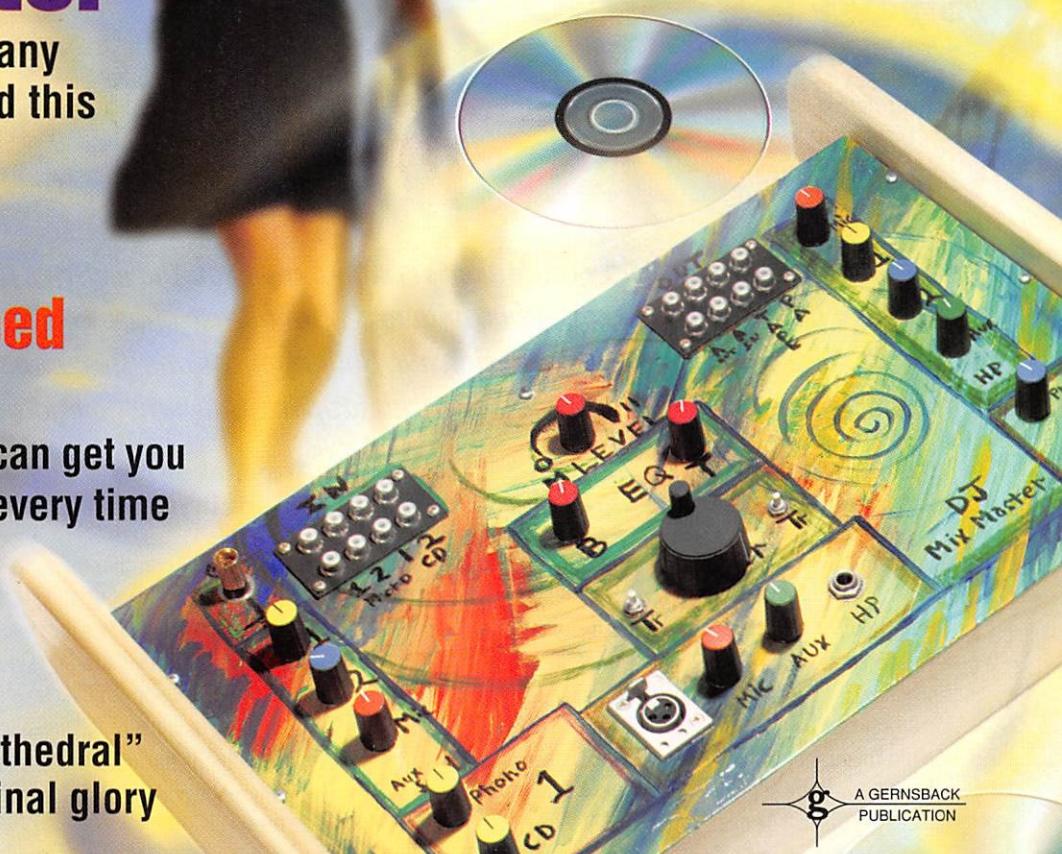
These hints and tips can get you perfect solder joints every time

Restoring a Classic

Bringing a 1930s "cathedral" radio back to its original glory

Measuring Capacitors And Inductors at RF Frequencies

The right way to get the right results



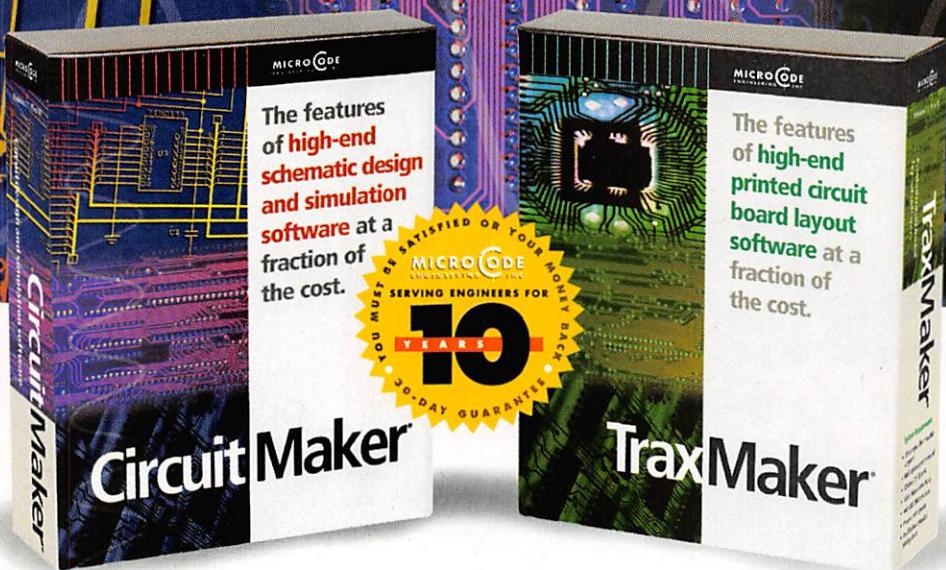
 A GERNBSBACK PUBLICATION

\$4.99 U.S.
\$5.99 CAN.

High-end features. Low-end price.

\$299

CircuitMaker 6:
Schematic design
and simulation
software



\$299

TraxMaker 3:
Printed circuit
board layout
software

CircuitMaker Version 6 and TraxMaker Version 3 give you the features of professional, high-end software at a fraction of the cost. Plus, with exceptional ease-of-use you'll spend less time learning to use the software and more time designing. Both applications are compatible with your existing software, and feature outstanding technical support. Call now for your free functional demo.

CircuitMaker 6 is a powerful schematic design and simulation program featuring:

- Professional schematic features including printout borders, title block and barred pin names
- Symbol editor and Macro feature for custom devices
- Fast, accurate SPICE3f5/XSPICE-based simulation
- Complete array of analysis types, including Fourier, AC, DC, Parameter sweep, Transient and more
- Virtual instruments including a digital oscilloscope, multimeter, Bode plotter, curve tracer and more
- Extensive library of over 4,000 models
- Tight integration with TraxMaker® for quick PCB layout
- Output PCB netlists in Protel®, Tango® and TraxMaker® formats for use in a variety of PCB layout programs
- Windows 3.1, 95 and NT

TraxMaker 3 is a powerful printed circuit board layout program featuring:

- Over 2,000 component footprints in a fully-documented, indexed library. Documentation shows footprints actual size
- Built-in autorouter and Design Rules Check
- Supports up to 6 signal layers plus power and ground planes, silk screen overlays and solder and paste masks
- Board sizes up to 32" x 32", with no pin limitations
- Intelligent manual routing with unroute capabilities
- Import any PCB netlist in CircuitMaker®, Protel® or Tango® format
- Output RS274X Gerber files, Excellon N/C drill files and Bill of Materials
- Print to any Windows-compatible printer or plotter
- Windows 3.1, 95 and NT

MICRO CODE
ENGINEERING INC

For free demo software, or to order, call **1-800-419-4242**

©1998 MicroCode Engineering, Inc. All rights reserved. CircuitMaker, TraxMaker, SimCode and MicroCode are registered trademarks of MicroCode Engineering, Inc. All other brand and product names are trademarks or registered trademarks of their respective companies.

CIRCLE 133 ON FREE INFORMATION CARD

CONTENTS

JULY 1999

ON THE COVER

31 DJ MixMaster

Have you ever wondered why some party DJs seem to sound better than the competition? Have you ever tried your hand at spinning tunes at a party only to find your efforts less than stellar? Well, the answer may lie largely in the mixing board. A good one can help anyone sound great; a less ideal one will make your mixes sound, well, less than ideal. The problem is that a good board can be very expensive, unless you build this month's cover project: A professional-grade mixing board with top-notch sound and some features not found on even the best commercial products.

— Jules Ryckebusch



TECHNOLOGY

16 Prototype

A "pill" monitor, ultracapacitors, super-fast on-the-job training, a long-distance spectral analyzer, and more.

40 Measuring Capacitors and Inductors at RF Frequencies

To get the right results you need to use the right techniques.

— Joseph J. Carr

48 A Super-Safe Smart Crosswalk

A new safety system that could help pedestrians avoid getting that "run down" feeling when crossing busy streets. — Bill Siuru

84 How to Succeed in Soldering

These tips and hints could be just what you need to get perfect results every time. — Skip Campisi, Jr.

AND MORE

2 EDITORIAL

12 LETTERS

96 ADVERTISING INDEX

3 Q&A

26 NEW PRODUCTS

96 ADVERTISING SALES OFFICE

28 NEW LITERATURE

As a service to readers, ELECTRONICS NOW publishes available plans or information relating to newsworthy products, techniques and scientific and technological developments. Because of possible variances in the quality and condition of materials and workmanship used by readers, ELECTRONICS NOW disclaims any responsibility for the safe and proper functioning of reader-built projects based upon or from plans or information published in this magazine.

Since some of the equipment and circuitry in ELECTRONICS NOW may relate to or be covered by U.S. patents, ELECTRONICS NOW disclaims any liability for the infringement of such patents by the making, using, or selling of any such equipment or circuitry, and suggests that anyone interested in such projects consult a patent attorney.

ELECTRONICS NOW, (ISSN 1067-9294) July 1999. Published monthly by Gernsback Publications, Inc., 500 Bi-County Boulevard, Farmingdale, NY 11735-3931. Periodicals Postage paid at Farmingdale, NY and additional mailing offices. Canada Post IPM Agreement No. 334103, authorized at Mississauga, Canada. One-year subscription rate U.S.A. and possessions \$24.99, Canada \$33.15 (includes G.S.T. Canadian Goods and Services Tax, Registration No. R125166280), all other countries \$33.99. All subscription orders payable in U.S.A. funds only, via international postal money order or check drawn on a U.S.A. bank. Single copies \$4.99. © 1999 by Gernsback Publications, Inc. All rights reserved. Printed in U.S.A.

POSTMASTER: Please send address changes to ELECTRONICS NOW, Subscription Dept., Box 55115, Boulder, CO 80328-5115.

A stamped self-address envelope must accompany all submitted manuscripts and/or artwork or photographs if their return is desired should they be rejected. We disclaim any responsibility for the loss or damage of manuscripts and/or artwork or photographs while in our possession or otherwise.

BUILD THIS

45 The RF Informant

This tiny, easy-to-build signal sniffer can do anything from finding hidden RF bugs and other transmitters to testing a microwave oven for leakage. — Rick Duker

DEPARTMENTS

7 SERVICE CLINIC

High-voltage problems in monitors. — Sam Goldwasser

13 DX LISTENING

The world of shortwave listening comes to Electronics Now. — Don Jensen

20 ANTIQUE RADIO

Restoring a cathedral radio. — Marc Ellis

22 COMPUTER CONNECTIONS

Digital audio and MP3.

— Konstantinos Karagiannis

25 EQUIPMENT REPORT

Matrix Multimedia PICtutor CD-ROM.

87 TECH MUSINGS

EIS impedance spectroscopy, new current sensors, and more. — Don Lancaster

Electronics NOW

Combined with
Radio Electronics®

Hugo Gernsback (1884-1967) founder

LARRY STECKLER, EHF, CET,
Editor-in-chief and publisher

ADRIA COREN, Vice President
KEN COREN, Vice President

EDITORIAL DEPARTMENT

CARL LARON, editor

JOSEPH J. SUDA, technical editor

EVELYN ROSE, assistant editor

MICHAEL A. COVINGTON, N4TMI
contributing editor

MARC ELLIS, contributing editor

SAM GOLDWASSER, service editor

DON JENSEN, contributing editor

KONSTANTINOS KARAGIANNIS,
computer editor

FRANKLIN J. MILLER, audio editor

DON LANCASTER, contributing editor

JANINE ABITABILE, editorial assistant

ART DEPARTMENT

ANDRE DUZANT, art director

RUSSELL C. TRUELSON, illustrator

PRODUCTION DEPARTMENT

KEN COREN

director of desktop production

RUBY M. YEE, production director

KATHRYN R. CAMPBELL
production assistant

MICHELE MUSÉ
production assistant

CIRCULATION DEPARTMENT

GINA GALLO

circulation director

CHRISTINA M. ESTRADA
circulation assistant

REPRINT DEPARTMENT

JANINE ABITABILE

reprint bookstore

Typography by Mates Graphics

Electronics Now is indexed in *Applied Science & Technology Index*, *Readers Guide to Periodical Literature*, *Academic Abstracts*, and *Magazine Article Summaries*. Microfilm & Microfiche editions are available. Contact reprint bookstore for details.

Advertising Sales Offices listed on page 96.

Electronics Now Executive and
Administrative Offices
1-516-293-3000.

Subscriber Customer Service:
1-800-288-0652.

Order Entry for New Subscribers:
1-800-999-7139.

VISIT US ON THE INTERNET AT
www.gernsback.com

EDITORIAL

Time Versus Money

In this month's Letters Column, reader Tom Gordon raises some serious disagreements with some of my earlier comments about the Internet (see the letter entitled "Editorial Comment" on page 12). In particular, he argues that the Internet is nothing more than another mass-communications media, and one that is expensive and supplies nothing that could not be obtained elsewhere. He is, of course, correct. He is also dead wrong. Let me explain.

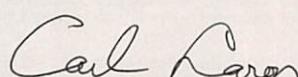
Yes, the information on the Internet is largely advertising driven. Many sites exist to promote those that set them up, turn to advertising banners and the like to "pay the freight," or do both. This is not in and of itself a bad thing, and it is certainly not new. As most recognize, the magazine you are reading now would flat out not exist were it not for our advertisers. The same is true for virtually any source of news or information: radio, TV, newspapers, professional journals, consumer magazines, etc., etc.

And while reader Gordon contends that little current content is available for free, that is actually far from the truth. Yes, many media and other informational sites are available only by subscription or offer limited editorial content, but many others offer the full text of their current editions for free, with only the annoyance of an advertising banner to "spoil" things. What's more, many media sites provide more in-depth coverage than can be accommodated in their native format, with most of that available for the asking. There are also many sites on the Internet that offer information that is available nowhere else. Those range from Net-only magazines such as the recently re-born *Byte* magazine (www.byte.com) to hobbyist labor-of-love sites like our own Sam Goldwasser's www.repairfaq.org, a compendium of practical information for those seeking to service all sorts of electronics equipment.

And yes, there is a cost involved in using the Internet, but access costs are dropping steadily and now there are even some practical alternatives that cost exactly zero. For example, NetZero (www.netzero.com) offers free Web and e-mail access nationwide. There is no set-up fee, the software is free for download, and there are no monthly connect charges. The catch is that the service is advertising driven, which means that you have to keep a small 1- by 3-inch or so advertising window open on your desktop while on-line. Still, free is free.

Anyway, in my mind, the real issue is not cost, but timeliness and accessibility. Can most of the information found on the Internet also be obtained from a library? Of course it can. But how many have a library on their desktop? Can we get much of the information via brochures, bulletins, etc.? Of course we can. But how many times is it far more useful to get that information today instead of tomorrow, or a week from tomorrow?

It all comes down to a question of value, or more accurately, time versus money, and that is a question only you can answer for yourself.



Carl Laron
Editor

Q & A

READERS' QUESTIONS, EDITORS' ANSWERS
CONDUCTED BY MICHAEL A. COVINGTON, N4TMI

ER...That Was A Joke!

Our April Fools' Day joke, "The EC909-12 Analog Microprocessor," apparently fooled a number of people too well—we've received a flood of mail about it.

Note that Ecraf is *farce* spelled backward, no address is given for any person or company involved, the claims are outlandish (such as emission of huge amounts of light—enough to light a city—at tiny currents), and the last paragraph of the article says it's due for release on April 1, our national day of tomfoolery.

Two items in "Prototype" (the DVD rewinder and the WIG-WOM) were also put-ons and also specifically mentioned April 1. But the equally improbable-sounding quantum tunneling transistor (pp. 42-43, 50) is real; see www.sandia.gov/media/quantan.htm for more information.

April Fool's jokes are a decades-old tradition at **Electronics Now**; our founder, Hugo Gernsback, published facetious articles under the name of Mohammed Ulysses Fips. Interestingly, though improbable at the time, some of the concepts in those articles—such as an optical audio disc—were uncannily predictive of the future. And that's the problem—one person's fiction can easily be another person's invention.

Ultrasonic Listener

Q Where can I find plans or a kit for a circuit to allow me to hear ultrasonic sounds such as bats' squeaks?—L. S., Newton, MA

A I'm not aware of a complete, published project or kit, but Fig. 1 shows a circuit you can experiment with. I used it successfully to listen to the squeaks of a domesticated rat.

The principle involved is *heterodyning* (mixing), a process that gives you the sum and difference of the original frequencies. For example, if you mix a 25-

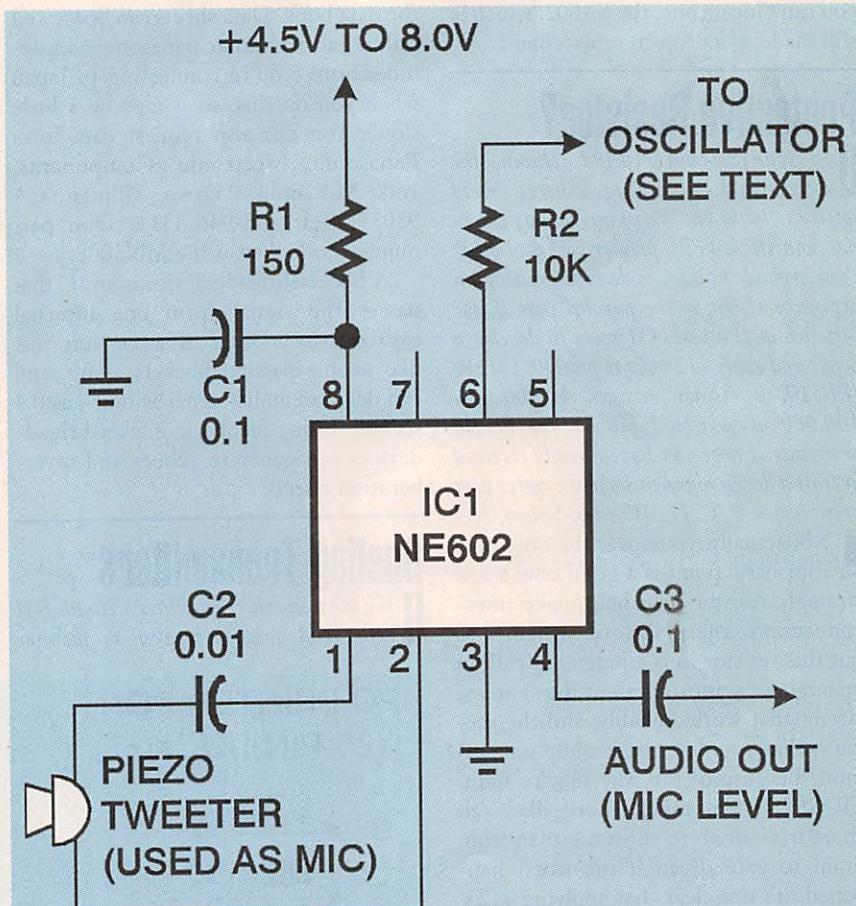


FIG. 1—HERE'S A GOOD STARTING POINT for an ultrasonic-listening circuit. The NE602 mixes 25-kHz ultrasound with a 20-kHz oscillator signal, yielding 5-kHz audio. If you can't find the now-discontinued NE602, the SA602 (still being made) is a direct replacement.

kHz incoming signal with the output of a 20-kHz oscillator, you get additional signals at $25 + 20 = 45$ kHz and $25 - 20 = 5$ kHz; the latter is audible.

Heterodyning takes place when one signal is multiplied by the other; that is, when the amplification of one signal is proportional to the signal level of the other. Any nonlinear amplifier will do this, but the NE602 chip shown in the circuit uses a sophisticated mixer called a *Gilbert cell* whose advantage is that not much of the original signal appears at the output.

The NE602 was designed for radio

receiver front-ends, and it works with low-level signals, so the microphone connects directly to its input. As shown, the microphone is connected differentially across pins 1 and 2. If one side of the microphone is grounded, you can connect the ungrounded microphone lead to C2 and add a capacitor, equal to C2, from pin 2 to circuit ground. Although the NE602 provides some amplification, the output signal is still microphone-level.

The design of the oscillator is up to you; its frequency should be adjustable so you can tune it near the ultrasonic

signal you want to hear. From R2 it goes directly into the base of a transistor. Logic-level (5-volt) oscillators work well; I used a signal generator for experiments, but a 555 chip would be a good choice when building a self-contained unit.

Note that the NE602 is no longer being manufactured, but should still be available from a number of sources. If you can't locate one, the SA602, which is still made, is a drop-in replacement.

Protective Resistor?

Q In your September 1998 column, the answer and Fig. 1 (Fig. 2 here) should specify a "build-out" resistance on any external connections to PC printer port pins other than ground. Failure to do so is inviting an expensive repair to the parallel port if, for instance in this case, Q1 were to develop a defect and apply +12 volts to pin D0. For the IRF510, a resistor between 10,000 and 100,000 ohms would provide the needed protection. I hope you have already received at least a dozen comments about printer port protection.—J. C. H., Winston-Salem, NC

A No, actually, yours was the only one. Your basic point is a good one; a few strategic resistors can help make interconnections safer. However, whether to put this resistor in is a judgment call; in general, we want to present the simplest circuit that works reliably, and the scenario that you describe is quite uncommon. Because of the way they're built, MOSFETs are much more likely to short from drain to substrate than from drain to gate. Even if the worst happened, it's not clear that applying +12V would actually damage a modern parallel port, which includes some protective resistance of its own; higher voltages certainly would, of course.

Because this circuit drives a relay, signal speed is not an issue, but in general, adding relays will slow down the charging of cable capacitance and gate capacitance. This can be good or bad. Small series resistors (on the order of 330 ohms) often make a long data cable work more reliably by reducing crosstalk. A resistor as large as 10,000 ohms, though, should be placed close to Q1, not at the PC, in order not to weaken the signal going into the cable.

Bucket-Brigade Devices

Q Back in the 1970s, there were audio delay chips called bucket-brigade analog delays.

Are they still being made? Are books about them available?—C. K. S., Waymart, PA

A Bucket-brigade delay devices are still made by Panasonic (Matsushita) and are available from Panasonic distributors, one of whom is Digi-Key, 701 Brooks Ave. S., Thief River Falls, MN 56701; Tel: 800-344-4539; Web: www.digikey.com. Digi-Key also sells the data book. Data sheets can be viewed online at www.mec.panasonic.co.jp/e-index.html (you're connecting to Japan when you do this, so it may be a little slow). You can also request data from Panasonic Electronic Components, 1600 McCandless Drive, Milpitas, CA 95035; Tel: 408-946-4311. One part number to look at is the MN3008.

A bucket-brigade device is an IC that passes the signal from one internal capacitor to another in succession, just like people passing buckets along, and can delay an audio signal as much as 0.4 second. Using feedback, bucket-brigade devices can generate echoes and reverberation effects.

Dueling Transmitters

Q We use a simple transmitter with an FM radio and outdoor speaker to monitor

activity on the internal phone line of the coal mine where I work. Teenagers in the area have started a community FM-broadcast station which interferes with our reception no matter where we tune the transmitter and radio. Can our transmitter be modified to tune somewhere in the 30-50 MHz range so we can use a scanner to monitor the activity in the mine?—D. B., Jesse, WV

A Probably, but let's solve the *real* problem instead. What you're experiencing is a conflict between two unlicensed transmitters, yours and theirs. Unlicensed transmitters are not allowed to interfere with licensed ones, so if the teenagers are keeping you from receiving FM broadcast stations (not just your own transmitter), you have a clear case against them. Contact the teenagers, explain the problem, and explain that you will report them to the FCC if they don't clean up their signal. Or, if you prefer, contact the Federal Communications Commission, Tel: 888-225-5322 and report the problem directly.

However, I believe that safety-critical communications should never rely on an unlicensed transmitter; you just have no assurance that your signals will not be interfered with. Consider relaying the

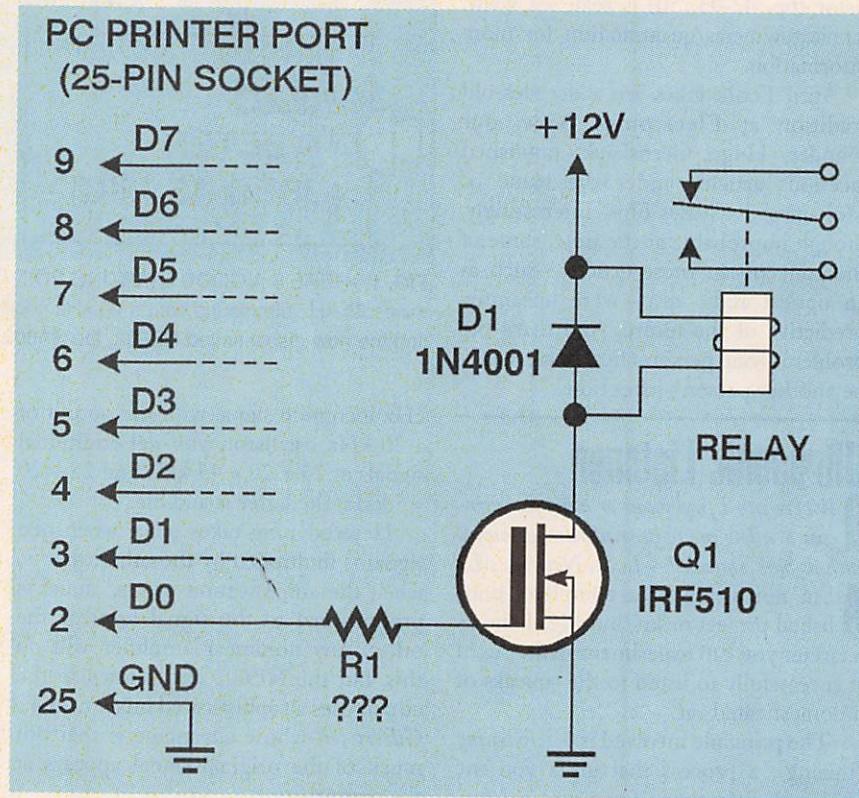


FIG. 2—ADDING A RESISTOR between the printer port and any external circuit connected to it could add protection in case of a failure, but is it really needed? See text.

signal by wire rather than by radio.

If you want to put your transmitter in the 49-MHz cordless-phone band, double the inductance of the tuning coil and double the capacitors in the tuned circuit (10 pF instead of 5 pF). However, you'll then be running a risk that your third harmonic (around 150 MHz) will interfere with police or public-safety communications. Go a little lower (120 MHz), and you'll interfere with aircraft communications instead. A low-pass filter and/or tuned antenna will be necessary to prevent these problems.

Dueling VCRs

Q When I record a program on my Magnavox VCR and play it back on my Zenith VCR, I get a picture but no sound. I'm feeding RF into my TV, so it isn't a broken audio cable. My Zenith VCR has no problem playing back pre-recorded tapes. What's wrong?—A. E., Glendora, CA

A Obviously, one of the VCRs is slightly out of specification, but without a third VCR to break the tie, it's hard to say which. It's possible both of them are

out of adjustment in opposite directions, so they're incompatible with each other even though they both play pre-recorded tapes. There are several electronic adjustments on a VCR that may need tweaking; if it were me, I'd take the Zenith unit in for a checkup first.

Shielded Car Speakers

Q My car stereo speakers create such a strong stray magnetic field that it is impossible to use a compass anywhere in the car. Is it possible to put some kind of magnetic shield around the speakers that will allow the compass to work undisturbed?—G. K., Euclid, OH

A Those must be fairly big speakers, since most car stereos do not interfere with compasses. Steel or iron shields may help a little, but the best tactic is probably to try to balance out the magnetic field using more magnets.

You indicate that you've already tried relocating the compass; have you also tried adjusting its compensation? Many compasses include tiny magnets that can be adjusted to counteract an ambient

magnetic field. Some stereo speakers, designed for use around computers, also include compensating magnets to reduce the total field strength outside the speaker enclosure.

We'd like to hear from readers who have addressed this problem.

Preventing Acoustic Feedback

Q I have a hearing problem and want to amplify the faint "beep-beep" from an electronic timer. Everything I build oscillates because of feedback from the microphone. Can you help?—J. B. W., Detroit, MI

A As you know, feedback squeals result when the same sound wave gets amplified over and over—it goes in the microphone, out the speaker, in the microphone again, and so on.

The best solution is to get rid of the microphone by making a direct electrical connection from the sounder in the timer to the input of your amplifier. Second best is to put the timer in a closed box with the microphone inside.

HOW TO GET INFORMATION ABOUT ELECTRONICS

On the Internet: See our Web site at <http://www.gernsback.com> for information and files relating to our magazines (**Electronics Now** and **Popular Electronics**) and links to other useful sites.

To discuss electronics with your fellow enthusiasts, visit the newsgroups `sci.electronics.repair`, `sci.electronics.components`, `sci.electronics.design`, and `rec.radio.amateur.homebrew`. "For sale" messages are permitted only in `rec.radio.swap` and `misc.industry.electronics.marketplace`.

Many electronic component manufacturers have Web pages; see the directory at <http://www.hitex.com/chipdir/>, or try addresses such as <http://www.ti.com> and <http://www.motorola.com> (substituting any company's name or abbreviation as appropriate). Many IC data sheets can be viewed online. www.questlink.com features IC data sheets and gives you the ability to buy many of the ICs in small quantities using a credit card. You can also get detailed IC information from www.icmaster.com, which is now free of charge although it formerly required a subscription. Extensive information about how to repair consumer electronic devices and computers can be found at www.repairfaq.org

Books: Several good introductory electronics books are available at RadioShack, including one on building power supplies.

An excellent general electronics textbook is *The Art of Electronics*, by Paul Horowitz and Winfield Hill, available from the publisher (Cambridge University Press, 1-800-872-7423) or on special order through any bookstore. Its 1125 pages are full of information on how to build working circuits, with a minimum of mathematics.

Also indispensable is *The ARRL Handbook for Radio Amateurs*, comprising 1000 pages of theory, radio circuits, and ready-to-build projects, available from the American Radio Relay League, Newington, CT 06111, and from ham-radio equipment dealers.

Copies of past articles: Copies of past articles in **Electronics Now** and **Popular Electronics** (post 1994 only) are available from

our Claggk, Inc., Reprint Department, P.O. Box 4099, Farmingdale, NY 11735; Tel: 516-293-3751.

Electronics Now and many other magazines are indexed in the *Reader's Guide to Periodical Literature*, available at your public library. Copies of articles in other magazines can be obtained through your public library's interlibrary loan service; expect to pay about 30 cents a page.

Service manuals: Manuals for radios, TVs, VCRs, audio equipment, and some computers are available from Howard W. Sams & Co., Indianapolis, IN 46214 (1-800-428-7267). The free Sams catalog also lists addresses of manufacturers and parts dealers. Even if an item isn't listed in the catalog, it pays to call Sams; they may have a schematic on file which they can copy for you.

Manuals for older test equipment and ham radio gear are available from Hi Manuals, PO Box 802, Council Bluffs, IA 51502, and Manuals Plus, PO Box 549, Tooele, UT 84074.

Replacement semiconductors: Replacement transistors, ICs, and other semiconductors, marketed by Philips ECG, NTE, and Thomson (SK), are available through most parts dealers (including RadioShack on special order). The ECG, NTE, and SK lines contain a few hundred parts that substitute for many thousands of others; a directory (supplied as a large book and on diskette) tells you which one to use. NTE numbers usually match ECG; SK numbers are different.

Remember that the "2S" in a Japanese type number is usually omitted; a transistor marked D945 is actually a 2SD945.

Hamfests (swap meets) and local organizations: These can be located by writing to the American Radio Relay League, Newington, CT 06111; (<http://www.arrl.org>). A hamfest is an excellent place to pick up used test equipment, older parts, and other items at bargain prices, as well as to meet your fellow electronics enthusiasts—both amateur and professional.

Reusing Exercise Bike Electronics

Q I just threw out my home exercise bike, but I kept the digital readout that was attached. Is there any way I can use it on my workbench? It used to indicate mode, distance, calories, time, and speed, and had a 2-wire cable and 3-volt batteries.—P. C., New York, NY

A That sounds like an interesting project; at the very least, you should be able to trick the timer into starting when you press a button. Readers?

Salvaged CD Drive

Q I recently salvaged the CD-ROM drive from an old computer. It has an audio headphone jack as well as an audio output on the back, but I can't get it to play a CD. Am I missing something obvious, or is it necessary to have the CPU and software wired in to make it work?—J. K., U. S. Air Force

A Unless the drive has a "play" button on the front, you're right, it requires commands from the CPU. An interesting project would be for somebody to reverse-engineer these commands and program a microcontroller to generate them so that you could attach a simple

one-chip circuit to the ATAPI (IDE) interface and turn an older CD-ROM drive into a CD player.

Telescope-Drive Parts Found

William Braell, of Harvard University, tells us that the TTD62103P chip that reader T.Q. needed (April 1999, p. 3) is probably a Toshiba TD62103P Darlington transistor array. (The Toshiba logo looks like another T preceding the part number.) Readily available substitutes are the NTE2013 or ECG2013. However, this chip was probably not damaged by accidental application of 30 volts.

Frank L. Scheder e-mails to tell us that the PMM8713 chip, needed by the same reader, is a rather old stepping-motor controller. We confirmed that it is still available for \$27.50 from B&D Enterprises, Main and Liberty St., Russell, PA 16345; Tel: 814-757-8300; Fax 814-757-5400; Web: www.bdenterprises.com

Still More Pinball Wizardry

Staci Steedum, of Wichita, KS, writes again to tell us that the best

source of information on pinball machines is *Star Tech Journal*, P.O. Box 35, Medford, NJ 08055; Tel: 609-654-5544; Web: www.startechjournal.com. They run a magazine, an online discussion forum, and a manual-reprint service covering coin-operated game machines of all ages.

Writing to Q&A

As always, we welcome your questions. The most interesting ones are answered in print. Please be sure to:

- (1) include plenty of background information (we'll shorten your letter for publication);
- (2) give your full name and address on your letter (not just the envelope);
- (3) type your letter if possible, or write very neatly; and
- (4) if you are asking about a circuit, include a complete diagram.

Questions can be sent to Q&A, **Electronics Now Magazine**, 500 Bi-County Blvd., Farmingdale, NY 11735, or e-mailed to q&a@gernsback.com, but please do not expect an immediate reply (because of our backlog) and please don't send graphics files larger than 100K. Due to the volume of mail, we regret that we cannot give personal replies. **EN**

• 68HC11 Micro-Controllers •

MRC1164GP (kit/assm)* - Controller w/ 64k \$77.95/\$97.95
MSCC11GP (kit/assm)* - Controller \$27.95/\$37.95

*Uses any 68HC11 Chip (sold separately) A1 \$5.95, E2 \$9.95, etc.



• 68HC11 Expansion Boards •

ME11GP (kit/assm) - 32k & I/O expansion board for the EVBU \$46.95/\$68.95
MRSXGP (kit/assm) - Sensor & I/O expansion board for MRC1164GP \$59.95/\$88.95

• Programmable Autonomous Mobile Robot Kits •

ROBOBUGGP (kit/assm)* - serious six-legged robot \$547.95/\$788.95
TAL2 (kit/assm)* - R&D robot vehicle \$495.95/\$798.95
TALJR (kit/assm)* - expert robot vehicle \$135.95/\$215.95

• Communications Boards •

*First-time buyers of Mekatronix™ brand products need the Com-Kit \$19.95 OR the Com-Pack \$27.95. The card plugs into the back of your PC's serial port/cable. You can then Program your robot or micro-controller in sBASIC, HC11 Assembly, C (ICC11), POGO, Forth or I.C.

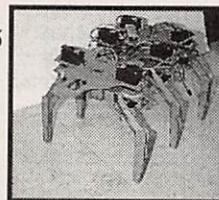
• Servos •

MS455RGP -42 oz-in dual ball bearing servo \$13.95
MS455HGP -Servo modified/continuous rotation \$19.95

• Software •

HSDL11GP - MC68HC11 115.2 Kbps downloader \$8.95/ W95
ICC11GP -v5 HC11 C-Compiler \$89.50 Dos /\$129.50 Win
TGPPD01 -Program disk w/ collision avoid. program \$8.95
TGPPD01 -Program disk w/ line following program \$19.95
TGPPSD -Example robot programs & source code \$28.95
TJAIPDGP -TJ Artificial Intell. program \$18.95
REMRPDGP -IR reading module for IR TV remotes \$38.95
EDUPD01GP -Software & Tutorial for Middle & High Schoolers \$28.95

Order Today!
Mention Ad#G2 for
FREE Insurance
on Your Order!



• Sensors/Emitters •

GP1UYRGP32/40 \$5.89/ \$3.49
32khz/40khz Infrared Digital Sensors
GP1UYHGP32/40 \$9.89/5.89
32khz/40khz Infrared Analog Sensors
MIR27ERGP \$1.39
Corresponding IR emitters

• MORE •

CCAMPALGP -Wireless color mini-camera spy \$328.95
BC12A500 -A/C adapter/robot battery charger \$9.55
AANCAGP -6 AA Rechargeable NiCad batteries \$13.55
IRREMPGP -Remote control module for Talrik Jr. \$22.95

Orders: Toll Free: 1-888-Mr-Robot
E-mail: sales@mrrobot.com

Full Web Catalog:

<http://www.mrrobot.com/>

or if above is busy try <http://users.aol.com/novasoft11>

For Technical Questions & other inquiries:
novasoft11@aol.com or 804-272-5752

Monitor High-Voltage Problems

IN ADDITION TO THE OBVIOUS "MONITOR SCREEN IS AS BLACK AS A COAL MINE" SYMPTOM, PROBLEMS IN THE HIGH-VOLTAGE POWER SUPPLY CAN RESULT IN A VARIETY OF BRIGHTNESS, RASTER GEOMETRY, AND OTHER PICTURE PROBLEMS AS WELL AS

arching corona, or other sights, sounds, and smells not normally associated with a properly functioning monitor. This month we will deal with some of these symptoms. Other video-related problems will be dealt with next time.

HV Power-Supply Fundamentals

Most monitors derive the high voltage for the CRT second anode (THE high voltage—called EHV by some), focus, and (sometimes) screen (G2) from the horizontal-deflection system (see Fig. 1). That technique was developed quite early in the history of commercial TV and has stuck for a very simple reason—it is very cost effective. A side effect is that if the horizontal deflection fails and threatens to burn a vertical line into the CRT phosphors, the high voltage dies as well. Of course, if the vertical deflection dies....

Some auto-scan monitors use a separate high-voltage supply. One reason for that approach is to decouple the horizontal deflection from the HV in auto-scan monitors, thus simplifying the design.

Usually that supply is a self-contained inverter module. It if can be opened, then repair may be possible. With a separate HV supply, there is no need for a HV flyback transformer on the mainboard. Some designs may use a separate HV supply including a flyback, which is part of the mainboard but is self-contained and independent of the hori-

zontal-deflection system.

Most TV and monitor (flyback) high-voltage supplies operate as follows:

1. The horizontal-output transistor (HOT) turns on during scan. The current increases linearly in the primary of the flyback transformer since it appears as an inductor. The magnetic field also increases linearly. Note: the flyback is constructed with an air gap in the core, which makes it behave more like an inductor than transformer as far as the primary drive is concerned.

2. The HOT shuts off at the end of the scan. The current decreases rapidly. The magnetic field collapses, inductively coupling to the secondary and gener-

ating a HV pulse. The inductance and capacitance of the flyback, snubber capacitors, and parasitic capacitance of circuitry and yoke form a resonant circuit. Ideally, the voltage waveform across the HOT during the flyback (retrace) period will be a single half cycle, and it is clamped by a damper diode across the HOT to prevent undershoot.

3. The secondary of the flyback is either a single large HV winding with HV rectifiers built in (most often) or an intermediate voltage winding and a voltage multiplier (see the section: "What is a tripler?" that follows). The output will be DC HV pulses.

4. The capacitance of the CRT envelope provides the needed filtering to adequately smooth the HV pulses into a DC voltage. Sometimes there is a separate HV capacitor as well.

5. A high-resistance voltage divider provides the several kV focus voltage and sometimes the several-hundred volt

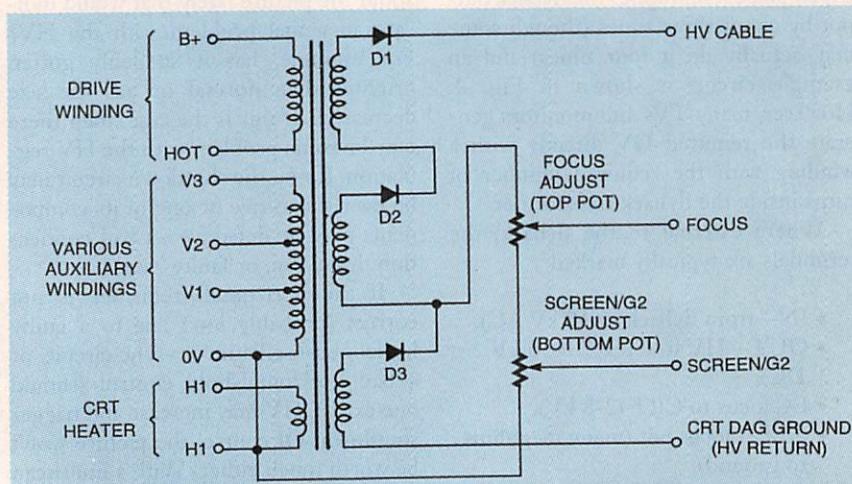


FIG. 1—MOST MONITORS DERIVE THE HIGH VOLTAGE for the CRT second anode, focus, and (sometimes) screen from the horizontal-deflection system.

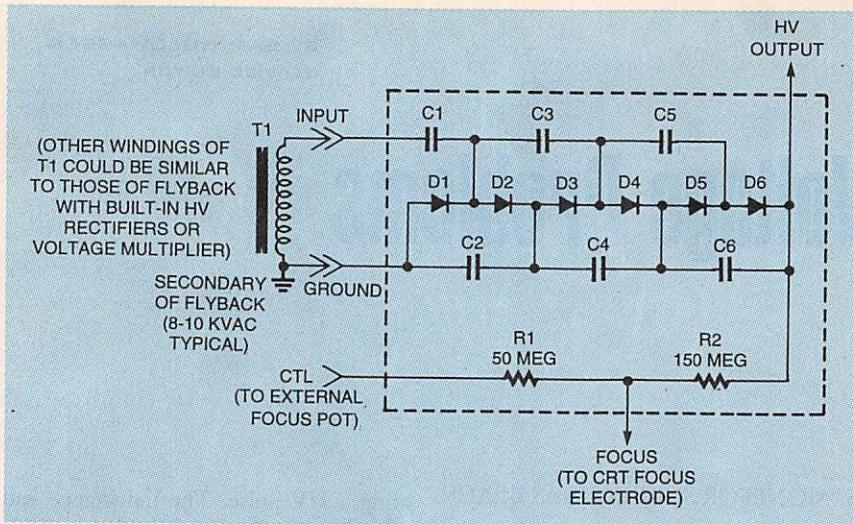


FIG. 2—THE FLYBACK TRANSFORMER only generates about 6-10 KV AC, which is then boosted by a capacitor-diode ladder (called a tripler) to the 18-30 KV needed for modern color CRTs.

screen (G2) voltage as well. Often, the adjustments for these voltages are built into the flyback. The focus and screen are generally the top and bottom knobs, respectively. Sometimes they are mounted separately. This or a similar divider may also provide feedback to control high-voltage regulation.

The operation of the deflection system was discussed in great detail in a pair of previous "Service Clinic" articles.

What Is A Tripler?

In some TVs and monitors, the flyback transformer only generates about 6-10 KV AC, which is then boosted by a capacitor-diode ladder to the 18-30 KV needed for modern color CRTs. The unit that does this is commonly called a tripler since it multiplies the flyback output by about three times (though some may actually do it four times) and an example circuit is shown in Fig. 2. However, many TVs and monitors generate the required HV directly with a winding with the required number of turns inside the flyback transformer.

Where external to the flyback, the terminals are typically marked:

- IN—from flyback (6-10 KV AC).
- OUT—HV to CRT (20-30 KV DC).
- F—focus to CRT (2-8 KV).
- CTL—focus pot (many megohms to ground).
- G, GND, or COM—ground.

Symptoms of tripler failure are: lack of high voltage or insufficient high volt-

age, arcing at focus-protection spark gap, incorrect focus voltage, other arcing, overload of HOT and/or flyback, or focus adjustment affecting brightness (screen) setting or vice-versa.

High-Voltage Shutdown

A monitor that runs for a while or starts to come on but then shuts down may have a problem with the X-ray protection circuitry correctly or incorrectly determining that the high voltage (HV) is too great (risking excessive X-ray emission) and shutting everything down.

A side effect of activation of this circuitry is that resetting may require pulling the plug or turning off the real (hard) power switch.

Was there anything else unusual about the picture lately that would indicate an actual problem with the HV? For example, has it suddenly gotten brighter than normal or has the size decreased? If this is the case, then there may be some problem with the HV regulation. If not, the shutdown circuit may be overly sensitive or one of its components may be defective—a bad connection, leaky cap, or faulty Zener.

If the horizontal frequency is not correct (probably low) due to a faulty horizontal-oscillator or -sync circuit, or a bad horizontal-hold control (should one exist!), HV may increase and trigger shutdown. Of course, the picture won't be worth much either! With a multiscan monitor, that could happen if the mode switching is faulty resulting in incorrect component settings for a given scan rate. A symptom might be HV shutdown

when switching scan ranges.

The HV shutdown circuit usually monitors a winding off of the flyback for a voltage that exceeds some reference and then sets a flip flop shutting the horizontal drive off. On some Sony models, a HV-resistive divider performs that function and these do fail—quite often. The red block called the "HSTAT module" or just that "big red capacitor thing" is a common cause of immediate or delayed shutdown on certain Sony monitors and TVs.

Low or No High Voltage

Most of these problems are due to faults in the horizontal deflection system—shorted HOT, shorted windings or HV rectifiers in the flyback, defective tripler, or other bad parts on the primary side of the flyback. In addition, with auto-scan monitors, the incorrect voltage or other component could be selected due to a logic fault or a problem with the selection relay or other circuitry.

However, if you discover an inch-deep layer of filth inside the monitor, the HV could simply be shorting out—clean it first.

In most cases, these sorts of faults will put an excessive load on the horizontal-output circuits so there may be excessive heating of the HOT or other components. You may hear an audible arcing or sizzling sound from internal shorts in the flyback or tripler. Either of those might get hot, crack, bulge, or exhibit visible damage if left on with the fault present.

Many modern monitors do not regulate HV directly but rather set it via control of the low-voltage power supply to the HOT (B+) via snubber capacitors across the HOT and the turns ratio of the flyback. The HV is directly related to the B+ so if that is low, the HV will be low as well. Faulty snubber capacitors will generally do the opposite—increase the HV and the X-ray protection circuits may kick in. However, low HV is also a possibility. The only way the turns ratio of the flyback can change is from a short, which will manifest its presence in other ways as well—excessive heating and load on the horizontal-output circuits.

While a shorted second anode connection to the CRT is theoretically possible, this is quite unlikely (except, as noted, due to dirt).

Excessive High Voltage

Any significant increase in HV

should cause the X-ray protection circuits to kick in and either shut down the set or modify the deflection in such a way as to render it harmless. Symptoms include arcing/sparking of HV, smaller than normal picture, and under certain scenarios, possible excessive brightness.

The causes of the HV being too high are:

1. Excess B+ voltage to the HOT. The likely cause is a low-voltage regulator failure.

2. Open snubber capacitors across the HOT. These are under a lot of stress and are located near hot components so failure is possible.

3. Incorrect excessively long scan drive to the HOT caused by failure of the horizontal-oscillator/-sync circuits. However, other things like the HOT will probably blow up first. The picture will definitely be messed up. This is more likely with auto-scan monitors than TVs since what is too long for one scan range may be correct for another and the selection circuitry is confused or broken.

4. The failure of the HV regulator. Actual HV regulators are uncommon today but the HV may be controlled by a feedback voltage from a divider (focus or screen, or its own), or a secondary winding on the flyback is used to set the B+ or drive timing. That could result in a picture that is underscanned (smaller than normal) and likely excessively bright as well.

Snaps, Crackles, and Other HV Breakdowns

Various problems can result in occasional or sustained sparking or arcing sounds from inside the monitor. Note that a static-electricity buildup is common on the front of the screen. It is harmless and there is nothing you can do about it anyhow.

The following sections deal with problems that could result in occasional or sustained sounds that are not commonly associated with a properly working TV or monitor. There may or may not be flashes or blanking of the screen at the same time as the audible noise.

Arcing, Sparking, or Corona From CRT HV Anode

The CRT HV anode usually appears as a red wire/suction cup. Symptoms could include a sizzling corona or more likely, an occasional or rapid series of sharp snaps—possibly quite loud and

quite visible—from the anode cap on the CRT to the grounded coating on the outside of the CRT or a chassis ground point (or any other conductor nearby). Corona is a high resistance leakage through the air without total breakdown. The snapping is caused by the sudden and nearly complete discharge of the CRT anode capacitance through a low resistance ionized path similar to lightning. There are two likely causes for this:

1. Dirt, dust, and grime around and under the suction cup on the CRT are providing a discharge path. This may be more severe in humid weather. Safely discharge the HV and then remove and thoroughly clean the HV suction cup and the area under it and on the CRT for several inches around the HV connection. Make sure there are no loose wires or other possible places for the HV to discharge to in the vicinity.

2. The high voltage has gone through the roof. Usually, the X-ray protection circuitry should kick in, but it can fail. If cleaning does not help, this is a likely possibility. See the "High Voltage Shutdown" and "Excessive High Voltage" sections earlier in this column for more.

Arcing at CRT Spark Gaps or Gas-Discharge Tubes

Spark gaps (see Fig. 3) and gas-discharge tubes are protective devices intended to break down and divert excessive voltage away from the CRT (usually). Arcing there is rarely due to a defective spark gap or gas discharge tube but rather is a safety mechanism like a fuse designed to protect the internal electrodes of the CRT if the focus or screen voltage should become excessive. The spark gap breaks down first and prevents internal arcing in the CRT.

Arcing at a spark gap or a glowing or a flashing discharge tube may be accompanied by total loss of picture or bad focus or brightness, focus fluctuations, or any of a number of similar symptoms. A common cause is a breakdown inside the focus divider (usually part of the flyback or tripler) but could also be due to excessive uncontrolled high voltage due to a failure of the B+ regulator or HOT snubber capacitor, or (ironically) even a short inside the CRT.

Spark gaps may be actual two- or three-pin devices with seemingly no insides and could be part of the CRT socket or printed on the circuit board

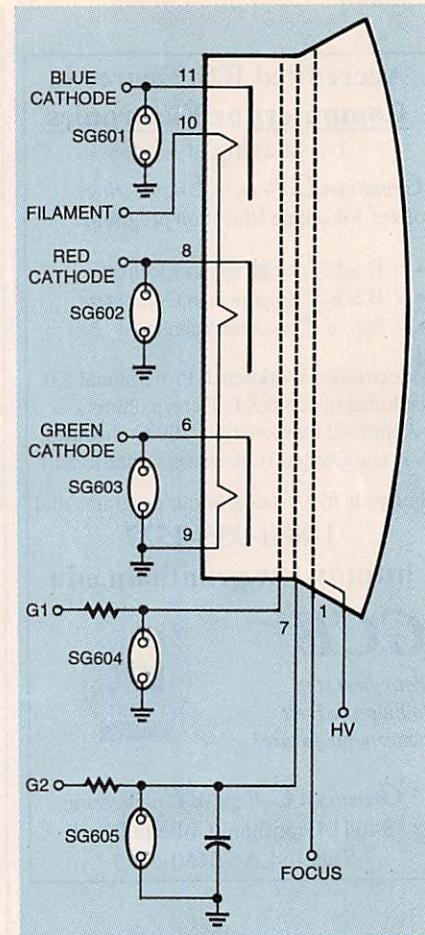


FIG. 3—SPARK GAPS are protective devices intended to break down and divert excessive voltage away from the CRT. If you see arcing within one, don't replace it—find out why.

itself. Gas discharge tubes look like small neon lamps (e.g., NE2) but could be filled with some other gas mixture to provide a controlled higher breakdown voltage. Since these are protective devices, like a fuse, don't just replace or disable them—locate and correct the underlying problem. The CRT makes an expensive fuse!

Arcing From Flyback or Vicinity

Arcing may be visible or audible and result in readily detectable levels of ozone. Note that very slight traces of ozone may not indicate anything significant, but if the TV smells like an office copier, there is probably some discharge taking place.

WARNING: It is possible for arcing to develop as a result of excessive high voltage. Symptoms might be a smaller than normal, excessively bright picture, but this may not be able to be confirmed until the flyback is repaired or replaced.

Accredited B.S. Degree in Computers or Electronics

by studying at Home

Grantham College of Engineering
offers 3 distance education programs:

- B.S.E.T. emphasis in Electronics
- B.S.E.T. emphasis in Computers
- B.S. in Computer Science

NEW!
Electronics Workbench Professional 5.0 included in our B.S.E.T. curriculums
-Approved by more than 200 Companies, VA and Dantes, (tuition assistance avail.)

For your free catalog of our programs dial

1-800-955-2527

<http://www.grantham.edu>

GCE

Your first step
to help yourself
better your future!



Grantham College of Engineering
34641 Grantham College Road
Slidell, LA 70460-6815

See the section: "Excessive High Voltage." Here's some of what you are likely to see or hear:

- On the HV output, it will probably be a loud snapping sound (due to the capacitance of the CRT) with associated blue/white sparks up to an inch or more in length. If the arc length is short enough, this may turn into a nearly continuous sizzling sound with yellow/orange arc and melting/burning plastic.

- Prior to the HV rectifier, it will likely be a continuous sizzle with orange/yellow/white arc and melting/burning plastic or circuit board material.

- Internal arcing in the flyback may be audible and eventually result in a bulging and/or cracked case (if some other component doesn't fail first as this would take some time to develop).

- A corona discharge without actual sparks or a visible well defined arc is also possible. This may be visible in a totally dark room, possibly more likely when the humidity is high. A thorough cleaning to remove all dust and grime may be all that is needed in this case.

- If the arc is coming from a specific

point on the flyback—a crack or pin-hole—this may be patched well enough to confirm that the rest of the monitor is operational and a new flyback is worth the money. Otherwise, there is no way of knowing if the arcing may have damaged other circuitry until a replacement flyback—possibly money wasted—arrives.

To attempt a repair when arcing is present, scrape off any dirt or carbon that is along the path of the arcing and its vicinity. Then clean the area thoroughly with alcohol and dry completely. Otherwise, the dirt and carbon will just act as a good conductor and the arcing will continue under your repair! Several layers of plastic electrical tape might be adequate for testing. Multiple coats of high-voltage sealer or *non-corroding* RTV silicone (if it smells like vinegar—acetic acid—as it cures, it could get in and affect the windings so don't use it) would be better if the objective is an actual repair. A thick layer of Epoxy may be even better and affected less by possible HV corona. Either of those might prove to be a permanent fix, although starting a search for a source for a new flyback would not hurt just in case. The arc most likely did damage the insulation internally, which may or may not be a problem in the future. Some more notes:

- In some cases, the pinhole or crack is an indication of a more serious problem—overheating due to shorted windings in the flyback or excessive secondary load.

- If the arc is from one of the spark gaps around the CRT or the CRT socket, this could also be a flyback problem indicating internal shorts in the focus/screen network.

- If the arcing is inside the CRT, this could indicate a bad CRT or a problem with the flyback focus/screen network and no or inadequate spark gap protection.

Where repair seems possible, first, clean the areas around the arc thoroughly and then try several layers of plastic electrical tape. If the monitor or TV works normally for say, an hour, then there is probably nothing else wrong and you can try for a proper sealing job or hope that tape holds out (put a few more layers on—each is good for about 8-10 kV theoretically).

However, replacement is really the

best long-term solution both for reliability as well as fire risk.

The CRT Return

The Aquadag coating on the outside of the CRT is the negative plate of the HV filter capacitor. If this is not solidly connected to the HV return, you will have your 25 kV+ trying to go where it should not be. There should be a wire solidly attached to the CRT neck board or chassis. Without this, voltage will build up until it is able to take some other path—possibly resulting in damage to sensitive solid-state components in the process. Therefore, it is important to rectify the situation.

Warning: If you find the CRT return disconnected, don't just attach it anywhere. You may instantly kill ICs or other solid state components. It must be connected to the proper return point on the CRT neck board or chassis.

Flashovers Inside The CRT

Due to sharp edges on the electron-gun electrodes, impurities, and other manufacturing defects, there can be occasional arcing internal to the CRT. Properly designed HV, deflection, and power-supply circuits can deal with these without failing, but not all monitors are designed well.

If your HV is not excessive, there is nothing you can do about flashovers. If these persist and/or become more frequent, a new CRT or new monitor will be needed.

Ozone Smell and/or Smoke From Monitor

Smoking is just as bad for monitors as for people, and usually more quickly terminal (no pun intended). White acrid smoke may indicate a failed electrolytic capacitor in the power supply, probably in conjunction with a shorted rectifier. Needless to say, pull the plug at once.

A visual inspection should be able to easily confirm the bad capacitor as it will probably be bulging and have condensed residue nearby. Check the rectifier diodes or bridge rectifier with an ohmmeter. Resistance across any pair of leads should be more than a few ohms in at least one direction. Remove the suspect device from the circuit to confirm. Both the faulty diode(s) and capacitor should be replaced (though the capacitor may work well enough to test with new diode(s)).

If a visual inspection fails to identify

the smoking part, you can probably plug the monitor in for a few seconds until the source of the smoke is obvious but be prepared to pull the plug in a real hurry. If the smell/smoke is coming from the flyback, then it has probably gone belly up. You may be able to see a crack or bulge in the case. While the flyback will definitely need to be replaced, it is likely that nothing else is wrong. However, it might be prudent to use a Variac when performing initial testing with the replacement just in case there is a secondary short circuit or excess HV problem.

X-ray and Other EM Emissions

X-ray radiation is produced when a high-velocity electron beam strikes a target containing heavy metals. In a modern monitor, that can only take place at the shadow mask/aperture grille and phosphor screen of the CRT. Really old TVs (prior to around 1975) may still have HV rectifier and regulator tubes—other sources of X-rays. However, modern TVs and monitors implement these functions with solid-state components.

For X-rays, the amount of radiation (if any) will be proportional to brightness. The energy (determined by the CRT high voltage, called kVP in the medical-imaging field) is not affected. This is one reason many monitors and TVs are designed with brightness-limiting circuits.

In any case, there will be virtually no X-ray emissions from the front of the CRT as the glass is greater than an inch thick and probably contains some lead for added shielding, but there may be some emission from the thinner sides. At 25-30 kV (quite low as X-ray energies go) X-rays will be stopped by almost any metal so what you have to worry about is where there are no shields.

However, realistically, there is very little danger. I would not worry about exposure unless you plan to be sitting for hours on the sides, behind, or under the TV or monitor—with a picture (there will be none if the screen is black).

It is interesting that even those 1.5-inch Watchman and 0.5-inch camcorder viewfinder CRTs have X-ray warning labels even though the high voltage used with these isn't anywhere near high enough to be of any concern!

Electromagnetic radiation (EM) is produced mostly from the deflection yoke and to a lesser extent from some of the other magnetic components like

transformers and inductors. Depending on monitor design (some are specifically designed to reduce this), EM emissions can vary quite a bit. Frequencies range from the 60 Hz of the power line or vertical scan rate to several hundred kHz in the AM-broadcast band. The intensity and spectral distribution will vary depending on horizontal and vertical scan rate.

As mentioned a second ago, a totally black screen will reduce X-ray emission to zero. It will not affect EM emissions significantly as most of this comes from the magnetic parts, particularly the deflection yoke.

There is no measurable microwave, IR, or UV radiation.

I refuse to get into the discussion of what, if any, health problems result from low level EM emissions. There is simply not enough data.

Wet Flyback

You put your can of Coke where????? Needless to say, if a liquid gets into the back of a TV or monitor, unplug it immediately. Inspect around the target area for obviously blown or damaged components. Test fuses and fusible resistors. Remove all traces of liquid—especially sugary or corrosive liquid. Use water first and then alcohol to promote drying. Repair burnt solder connections and circuit board traces. Once the monitor is entirely dried out, power it up—preferably through a series light bulb and/or Variac until you are sure nothing else will let loose. Look, listen, and smell for any unusual behavior. If it now works, then consider yourself lucky. If not, there may be damage to transistors, ICs, or other components.

Another source of liquid-related damage is using spray cleaner or a too wet rag on the front of the CRT (or other parts of the monitor, for that matter). Any liquid that drips inside (all too likely) may short out circuitry on the mainboard with very expensive consequences.

Erratic Focus or Screen Voltage

Symptoms here could include fluctuating focus or brightness. In extreme cases, the result may be a too bright or dark picture or other behavior caused by breakdown in the focus/screen(G2) divider network.

Usually, this problem will require flyback replacement to repair reliably. Sometimes, the section with the controls

can be snapped apart and cleaned, but this is not common.

First, just try rotating the screen (G2) control back and forth a few times. This may clean up the contacts and eliminate the erratic behavior. Possibly, positioning it a bit to one side of the original location will help. Then, use the individual or other master background/bias adjustments to compensate for the improper brightness.

If pressing in on the erratic control helps to stabilize the setting, you might try adjusting it to the optimal position and then put a dab of hot-melt glue (or Superglue if you can manage not to stick your fingers together) on the shaft to hold it with a little more contact force.

If none of this helps, here's a "well it's going in the dumpster anyhow" procedure to try:

After discharging the CRT (so you don't get zapped) drill a tiny hole in the plastic cover near the bad control. Be careful you don't damage anything inside—you just want access to the contacts of the controls. Use a hand drill with, say, a 1/16-inch bit. Don't drill more than about 1/8-inch deep, which should enter the airspace. Then spray some contact cleaner through the hole and work the controls. Wait sufficient time (say, 24 hours) for everything to dry COMPLETELY and see if behavior changes (or if it works at all).

Again, this is a "you have got to be kidding" type of repair so no guarantees, and only use this as an absolute last resort before disposal. If by some miracle it does work, fill the hole with a drop of RTV or just put a couple of layers of electrical tape over it.

Wrap Up

That's it for now. Next time we will continue our discussion of monitor troubleshooting and repair. Until then, check out my Web site, www.repairfaq.org. I welcome comments (via e-mail only please at sam@stdavids.picker.com) of all types and will reply promptly to requests for information. See you next time!

MAY THE SOURCE BE WITH YOU

Tap into THE SOURCE of useful government publications—the free CONSUMER INFORMATION CATALOG.

Call toll-free 1-888-8 PUEBLO.



LETTERS

SEND YOUR COMMENTS TO THE EDITORS OF ELECTRONICS NOW MAGAZINE

Brainstorm Caution

I would like to comment on the project in the "Learn to Relax with a Brainwave Synchronizer" article in the April 1999 issue. There may be dangers in its use. First of all, a little background: I hold an M.Sc. in Electrical Engineering, with a specialty in biomedical instrumentation, and my 1979-80 thesis research and course work concentrated in electroencephalographic instruments and general neurology instruments. In 1981, I was board certified as a Certified Clinical Engineer. I am also an epileptic.

During the 1970s, when I was really deep into medical instruments, I became interested in biofeedback and did some preliminary research with the goal of building an alpha-wave monitor. After researching the issue and talking to a couple of neurophysiologists and neurologists, I elected to drop the project because I learned that alpha monitors can reinforce latent epileptic seizure activity.

I also learned during my studies that "photo driving" is one way to elicit an epileptic seizure. When I go for my regular EEG every five years, one of the things they do is place a mask over my face and flash a light at me. I am told that lights blinking, especially in the region of the flicker fusion frequency (about 8 Hz), can elicit a seizure. That's why some municipalities in the 1970s banned strobe lights in that frequency range from discos (of course, how can they tell the difference between a dance and a seizure in those places?). Recently, in Japan, a blinking television cartoon created widespread seizure activity in child viewers.

Blinking lights apparently can be dangerous. Because of what I have learned, I would be really reluctant to strap on one of those things. After all, a similar experience is used to artificially generate a seizure when the neurologist wants to examine my brain waves.

NAME WITHHELD

Editorial Comment

Carl Laron's editorial in the February issue extolled the Internet as if it were a miracle rather than simply one mass communication medium among several. For many people, if not most, the necessity of another mass communication medium is moot. This is especially true in light of the fact that the Internet or Web is primarily a vehicle for advertising. That information offered by the Web which is not advertising is largely information which can be released for free, i.e. the kind of information we would typically get in free brochures, pamphlets, bulletins, listings, and the like.

On the other hand, information that is costly to produce and can be published for compensation is not going to appear on the Web. Exceptions to this can be found in texts and articles that have already been so published and are being recycled via the Web, e.g. ten-year-old magazine articles. In general, the Web cannot compete with well-stocked university libraries as a serious research tool.

In light of the above, it's interesting to note that Britannica, Inc. maintains a Web site at which articles from their encyclopedia can be downloaded, but this is a paid site. If one is going to pay monthly or yearly fees to use this site, then those fees must be weighed against what one is already paying in local taxes

to support libraries, which will have the encyclopedia in it anyway. There are free encyclopedias available on the Web, but you can be certain that they are not on the scholarly level of the Britannica to say nothing of Britannica Inc.'s Macropedia.

Finally, we note that the Web doesn't replace anything. It only competes with already existing media even though many of those media use the Web as an extension of themselves: Every magazine and television station has a Web site. The objective is obvious. Further, when all costs and fees are considered, the Web from the standpoint of the individual is the most expensive mass communication medium yet developed. In order for me to embrace such a medium it would have to be extraordinarily inexpensive or of extraordinary quality. The Web is neither.

TOM GORDON
Sunnyvale, CA

See the editorial on page 3 for our response to this letter—Editor

More April Fooled

I just got my April issue, and I read the article on the analog microprocessor replacement for the Pentium II. I'm ashamed to admit it, but you guys really had me going. I couldn't believe (or, worse yet, I did) the amazing capabilities of the microprocessor based on the new "Barrier Reflex Diode." I even went so far as to search for information about it with Yahoo! Boy, am I gullible!

All hail Dr. Ecraf and his incredible farce!!
JOHN VOLTZ
via e-mail

Shame on you! Fake articles about super processors...what a cruel thing to do to a bunch of computer junkies. You got me!

CRAIG MCGREGOR
via e-mail

Write To:
Letters,
Electronics Now Magazine,
500 Bi-County Blvd.
Farmingdale, NY 11735

Due to the volume of mail we receive, not all letters can be answered personally. All letters are subject to editing for clarity and length.

Hello, Again!

DON JENSEN MAY BE NEW TO ELECTRONICS NOW BUT HE'S BEEN AROUND SHORTWAVE LISTENING SINCE 1947, WHEN AT AGE 11, HE TUNED HIS FIRST SW STATIONS ON AN OLD "ALL-BAND" CONSOLE RADIO. FOR A NUMBER OF YEARS, HIS

"DX Listening" column has been a regular feature in our sister publication, *Popular Electronics*. Regular readers know his column is the place to go for all the latest...what's on shortwave, and where and when to tune. For those who haven't yet discovered the fun of SWLing, why not turn on and tune in to "DX Listening"?

Now that the introductions are out of the way, let's get right to this month's news and views.

Shortwave in Venezuela

Once upon a time, Venezuela was one of the most "radio active" shortwave countries in South America. As recently as 1985, there were about 60 SW different outlets in this country of some 20 million people. From 1985 to 1988, the number dropped by two-thirds. And as this is written, there may be only four Venezuelan shortwave broadcasters still regularly on the air.

Part of the reason seems economic. In the 1980s, Venezuela was one of the region's more prosperous nations, thanks to its petroleum resources. But crude oil prices fell, and economic difficulties followed. A second reason for the decrease in the number of Venezuelan

CREDITS: Dustin Brann, MO; David Clark, ONT; Fred Kohlbrenner, PA; David Krause, OH; William McGuire, MD; Conrad Routh, GA; Gerald Witham, HI; North American SW Association, 45 Wildflower Road, Levittown PA 19057.

shortwave outlets has been the shift to FM broadcasting, a phenomenon also noted elsewhere in Latin America in recent years.

For shortwave listeners, the decline is particularly disappointing, since Venezuela has long been one of the most interesting DX targets in our hemisphere.

Venezuela, geographically the "crown" atop South America, is a land about seven times as large as New York State, composed of 20 states and two large interior federal territories, and is largely undeveloped and under populated. Most Venezuelans live in the urban-

ized northern valleys of the *Cordillera de Merida*, the upper end of the Andean chain. The country's white population comprises about 20 percent of this Spanish-speaking country, with some 70 percent *mestizo*, or mixed white and Indian,

Despite the language barrier—almost all shortwave programming has been and continues to be in Spanish—Yankee listeners enjoy tuning these SW stations. Traditionally, they have been quite easy to hear, with their signals often loud and clear in North America. But even more so, SWLs have long loved the Venezuelan music, galloping *cumbias*, and pepper-hot Latin rhythms.

And though the number of Venezuelan SW stations has dwindled down to a precious few, the quality of the musical programming remains. Who knows what the future holds, but for now, enjoy those stations that are left.



LOGO OF ONE OF THE FEW VENEZUELAN shortwave stations still on the air. The Spanish slogan suggests listeners keep their radios tuned to Radio Valera.

Let's look at the last Venezuelan SW broadcasters, and one or two more that might return to the air in the future:

The two best bets for SWLs are *Ecos del Torbes* and *Radio Tachira*, both located in the same city, San Cristobal, an urban center about 400 miles southwest of Caracas, near the border with Colombia. Set in a mountain valley, along the Torbes River, San Cristobal, with a population of nearly a quarter million, is the largest city in Venezuela's Andean region. Founded in 1561, the city retains something of its colonial atmosphere.

Ecos del Torbes—identifying, phonetically, as "A-kos del TOR-bays"—is best heard on 4,980 kHz, and sometimes also on 9,640 kHz, *Radio Tachira*—phonetically, "RAHD-yo Tak-YEAR-ah"—broadcasts on 4,830 kHz, where there may be interference from another Spanish-speaking station in Costa Rica.

Look for both Venezuelan outlets during the evening hours, until 0400 UTC, and again in the early morning, from around 0900 UTC.

Further east, in the state of Trujillo, is Valera, located just south of the famed Pan American Highway and gateway to the oil-producing area around Lake Maracaibo. Valera is substantially smaller than San Cristobal, with a population of only 80,000. There is where you will find *Radio Valera*, which is heard reasonably often in the U.S., despite its only modest shortwave power of just 1 kilowatt. *Radio Valera* broadcasts on 4,840 kHz, on a similar schedule, between 0900 and 0400 UTC.

The fourth Venezuelan SW station still heard some days is *Radio Amazonas* in Puerto Ayacucho. As its name suggests, it broadcasts from the remote southern Amazon region on the Colombian border, in a small—10,000 population—riverport town on the Orinoco River. Shortwave tends to still thrive in such frontier towns. *Radio Amazonas* transmits on 4,940 kHz with 1 kilowatt power (like *Radio Valera*) from 0900 to 0400 UTC.

In the Venezuelan capital, Caracas, only the government station, *Radio Nacional* still has shortwave-transmitting facilities. But the station, which in the past has aired programs for listeners outside Venezuela, hasn't been heard on its normal frequency of 9,540 kHz during most of the last year.

Missing from shortwave for several years is *Radio Rumbos*, also in Caracas, which remains a major Venezuelan

broadcaster, but, according to its Web site—www.tycom.com.ve/rumbos/—only on the FM band. It once was perhaps the easiest Venezuelan SWer to hear on 4,970 and 9,660 kHz, and, periodically, there are rumors that it may return.

Also in the "maybe someday" category is *Radio Barquisimeto*, in the city of the same name, which used to be heard on 9,510 kHz but is today silent on shortwave. There have been reports that this station intended to return to SW to broadcast Spanish-language baseball games of its local team, the Lara Cardinals. So far this hasn't happened, but stay tuned....

Hurricane Hunting

This is the season for tropical storms and hurricanes in the Atlantic, Caribbean, and Gulf of Mexico, and that can mean some interesting listening for SW enthusiasts living far from the danger track. For those living in harm's way, potentially it can be far more important.

Geoff Williams, writing in *Contact*, the monthly publication of the World DX Club, is a self-described Hurricane Hunter, and offers some times and frequencies for like-minded listeners.

Worth checking are the frequencies used by *CAMSLANT*, the Coast Guard Area Master Station, Atlantic. Those shortwave voice signals are all in the Upper Sideband (USB) transmission mode, which can be tuned quite easily on most modern SW receivers.

Offshore forecasts are transmitted at 0330 and 0930 UTC on 4,426, 6,501, and 8,764 kHz, and at 1600 and 2200 UTC on 6,501, 8,764, and 13,089 kHz. These include the west central North Atlantic from 32 to 41 degrees North Latitude and west of 65 degrees West Longitude; south west North Atlantic; the Gulf of Mexico; the Caribbean, and (except for the 0330 UTC transmission), the offshore waters east of New England north of 41 degrees North Latitude and west of 60 degrees West Longitude.

The High Seas forecasts, Williams notes, are aired at 0500 UTC on 4,426, 6,501, and 8,764 kHz; 1130 and 2330 UTC on 6,501, 8,764, and 13,089 kHz; and 1730 UTC on 8,764, 13,089, and 17,314 kHz. These include forecasts for North Atlantic waters north of 03 degrees North Latitude and west of 35 degrees West Longitude, plus areas of the Gulf of Mexico and the Caribbean Sea.

Additionally, *WOM*, a marine communications station operated by AT&T from Rennsucu/Fort Lauderdale, FL, airs weather forecasts, including hurricane information, at 1300 and 2300 UTC, on 4,363, 8,722, 13,092, 17,242, and 22,738 kHz.

Williams suggests the SWLs get a large Atlantic area map and plot the hurricanes from the time they form, usually off the west coast of Africa, for four or five days, until they begin to threaten the West Indies and the south and east coasts of the U.S.

One For The Zipper

Radio Netherlands is airing something it says is a refreshing change from dry and maybe somewhat stuffy traditional newscasts. If that's what you're looking for, you may want to check out the Dutch shortwaver's weekly news summary called "Europe Unzipped."

A zippy compilation of news and views is what *Radio Netherlands* calls its roundup of the previous week's happenings around Europe, including a mix of offbeat items that never made the headlines. James McDonald, one of the show's on-air personalities, says "It's important to give listeners an authoritative news service, but it still can be bright and lively."

Look for this one on Sundays at 0043 and 0443 UTC (Remember those would equate to Saturday night in North America). As of this writing, the frequencies are 6,165 and 9,845 kHz for the first transmission; 6,165 and 9,590 kHz for the second.

Down The Dial

What are you hearing? Have you questions about shortwave listening, or when and where to tune certain world band stations? Would you like to send a photo showing you tuning your SW

ABBREVIATIONS

- DX—Distant broadcasting stations
- FM—Frequency modulation, a broadcasting mode
- kHz—Kilohertz, unit of frequency measurement
- SW—Shortwave
- SWL—Shortwave listener
- UTC—Universal Coordinated Time, the world time standard used by shortwave listeners and many broadcasters. It is equivalent to Eastern Daylight Time plus 4 hours; CDT plus 5 hours; MDT plus 6 hours, or PDT plus 7 hours.

receiver, to appear in the "DX Listening" column? If so, just send your letter to me, Don Jensen, at Electronics Now, 500 Bi-County Blvd., Farmingdale, NY 11735. In the meantime, here are some SW targets, times and frequencies to try.

GUYANA—3,290 kHz, *Guyana Broadcasting Corp.* is noted from before 0400 UTC with local news, followed on the hour by a relay from the British Broadcasting Corp. Or look for this station during the early morning hours, after 0900 UTC, when it airs "The Early Bird Show."

HUNGARY—3,975 kHz, *Radio Budapest* is noted here at around 0500 UTC with music and identification. There is an interesting group of European broadcasters that operate in this offbeat frequency band during the late evening hours. Besides Budapest, they include the *British Broadcasting Corp.* on 3,955 kHz; *Radio France International* on 3,965 kHz and Germany's *Deutsche Welle* on 3,995 kHz.

MEXICO—9,705 kHz, *Radio Mexico International* has bi-lingual Spanish and English programming around 1330 UTC, with mellow Mexican music and sports.

PARAGUAY—9,736 kHz, *Radio Nacional* may not be the easiest Latin station to hear, but it is one of the few ways to log this South American country on shortwave. Try early mornings, after 1000 UTC, for the station's "Simbolia Nacional" program with lots of mellow music.

UNITED ARAB EMIRATES—13,675 kHz, *Radio Dubai* is one of the solid SW signals broadcast from this Persian Gulf station. It has English at 0330 UTC, with station identification, world news, and regional weather forecast, followed by feature programming.

YUGOSLAVIA—11,870 kHz, Belgrade's *Radio Yugoslavia* broadcasts in English at 0430 UTC, with tuning signal, identification, and a newscast.

EN

There's a life
to be saved right now.

Please give blood.

Call 1-800 GIVE LIFE



Ad
Council

Electronics CD ROMs

Want to improve your design skills?

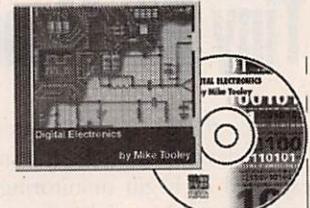
produced by:
matrix
multimedia

Then you should consider our range of CD ROMs by best-selling author Mike Tooley.

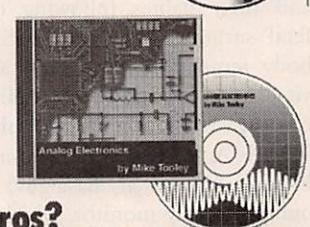
Electronic Circuits and Components provides a sound introduction to the principles and applications of the most common types of electronic components and how they are used to form complete circuits. Sections on the disc include: fundamental electronic theory, active components, passive components, analog circuits and digital circuits. Includes circuits and assignments for Electronics Workbench.



The Parts Gallery has been designed to overcome the problem of component and symbol recognition. The CD ROM will help students recognize common electronic components and their corresponding symbols in circuit diagrams. Quizzes are included. The Parts Gallery is free with Electronic Circuits and Components.



Digital Electronics details the principles and practice of digital electronics, including logic gates, combinational and sequential logic circuits, clocks, counters, shift registers, and displays. The CD ROM also provides an introduction to microprocessor-based systems. Includes circuits and assignments for Electronics Workbench.



Analog Electronics is a complete learning resource for this most difficult subject. The CD ROM includes the usual wealth of virtual laboratories as well as an electronic circuit simulator with over 50 pre-designed analog circuits, which gives you the ultimate learning tool. The CD ROM provides comprehensive coverage of analog fundamentals, transistor circuit design, op-amps, filters, oscillators, and other analog systems.

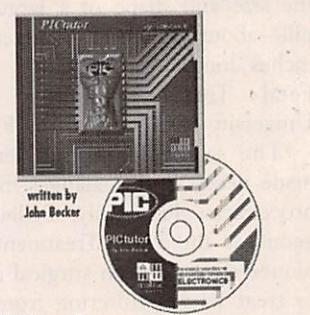
"...hammers home the concepts in a way
that no textbook ever could."

Electronics Australia

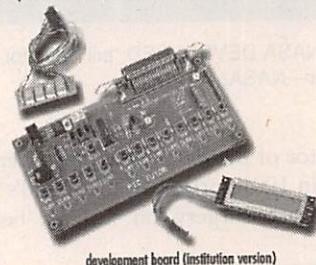
Interested in programming PIC micros?

We have the perfect solution:

Our PICtutor CD ROM can teach you how to write assembly language programs for the PIC series of microcontrollers. The CD ROM's 39 tutorial sections will guide you from basic PIC architecture, commands, and programming techniques up to advanced concepts such as watchdog timers, interrupts, sleep modes, and EEPROM data memory use. Over 80 exercises and challenges are provided to test your understanding, and the unique Virtual PIC allows you to write and test programs on-screen.



The complementary development kit includes a reprogrammable PIC16C84, which you can program via your printer port. The institution version (designed for use in schools, colleges and industry) includes a quad 7-segment LED display and alphanumeric LCD display. The development kit provides an excellent platform for both learning PIC programming and for further project/development work. Assembler and send (via printer port) software is included on the CD ROM.



Prices and Versions

Institution versions are suitable for use in schools, colleges and industry.
Student versions are for student/home use.

	student version	institution version
Electronic Circuits & Components	\$56	\$159
Digital Electronics	\$75	\$189
Analog Electronics	\$75	\$189
PICtutor (CD and development board)	\$179	\$350

Shipping costs to Canada an additional \$5. Overseas orders please contact Claggk Inc. for shipping costs.

see <http://www.MatrixMultimedia.co.uk> for full specs and demos

Please circle the products you would like to buy on the table above right, calculate the total cost, fill in the form below and send it to us. Please allow 4-6 weeks for delivery.

Name: _____

Address: _____

Zip: _____ Telephone: _____

I have enclosed my check for \$: _____

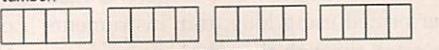
Please charge my credit card for \$: _____

Note that the delivery address and the address at which the card is registered must be the same.

Card type: _____

Mastercard, Visa, or Discover only

Signature: _____ Number: _____



Expire date: _____ CL02

Order Form



Claggk Inc., PO Box 4099, Farmingdale, NY 11735-0792

Tel: 516-293-3751

email claggk@poptronix.com

Proto type

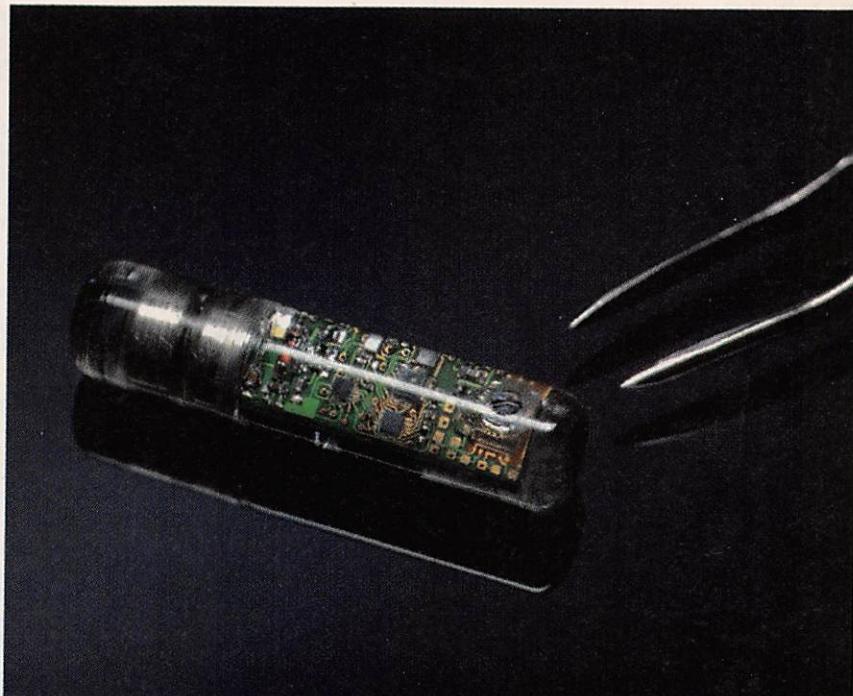
Tiny Pill Monitors Vital Signs From The Inside

By the end of this year, a NASA-developed "pill transmitter" is expected to begin monitoring mothers and their babies following corrective fetal surgery. The "pill" will monitor body temperature, pressure and other vital signs in the womb, radioing this critical information to physicians. NASA's Ames Research Center, Moffett Field, CA (www.arc.nasa.gov) is developing the tiny monitor, which is about the size and shape of a large vitamin pill—about $\frac{1}{2}$ inch in diameter and $1\frac{1}{2}$ inches long, in cooperation with the Fetal Treatment Center at the University of California, San Francisco.

The search for a tiny sensor was made necessary by changes in surgical procedures. Previously, Pediatric surgeons at the Fetal Treatment Center pioneered a cesarean surgical approach to treat fetuses suffering from various birth defects including congenital diaphragmatic hernia. In that condition, a hole in the baby's diaphragm lets internal organs shift from inside the abdomen into the chest cavity, leaving insufficient room for lung development. Sixty to 75 percent of babies born with this condition perish.

Now, however, surgeons have shifted toward using endoscopic techniques. Normally, an endoscope is used to see into the interior of a body or hollow organ. Endoscopic instruments are now also used more frequently in surgeries requiring smaller incisions. During the endoscopic procedure, the surgeons make small incisions through the mother's abdominal wall through which tiny tubes are inserted. The surgery is then performed using long, thin instruments inserted through the tubes.

"This minimally invasive method represents the future of fetal surgery," said Michael Harrison, M.D., founding



THE NASA DEVELOPED "pill" monitor looks much like a large vitamin pill. (Photo by Tom Trower—NASA)

director of the Fetal Treatment Center, who in 1981 performed the world's first corrective surgery on a fetus before birth.

Operating on a fetus, however, presents some hard-to-solve difficulties. "Nearly every time doctors operate on a fetus, the mother will later undergo pre-term labor that must be monitored," said Dr. Carsten Mundt, an electrical engineer on the Sensors 2000 team at Ames. "Pre-term labor is a serious problem that is difficult to predict and monitor with conventional equipment, and often leads to the death of the baby." When doctors are able to monitor the magnitude and frequency of uterus contractions, they can identify the onset of pre-term labor early enough to prevent

it from becoming life threatening to the fetus.

Previously, physicians implanted larger sensor-transmitters to monitor mother and baby. With the switch to endoscopic techniques, however, that was no longer practical. What was needed was a much smaller monitoring device. Since there were no commercially available sensors small enough for the task, NASA developed one that could fit through the endoscopic equipment. The result was the pill monitor.

The pill monitor measures the pressure of uterine contractions and temperature of amniotic fluid. The next generation of the monitor will also measure the pH of the fluid. Eventually, a smaller monitor will gauge the electrical



THE MONITOR IS SHOWN HERE with an endoscopic tube through which the "pill" can be placed inside the body.

activity of the fetal heart and transmit the data, along with measurements of the baby's body chemicals, including carbon dioxide, glucose, and ionic calcium. The pill transmits the information to the physicians at radio frequencies.

The tiny monitor could be used for other applications such as measuring core body temperature, monitoring patients for shock or checking intestinal pressure changes or stomach acidity in ulcer patients. In addition, NASA is developing a small, flat monitor that could be taped to the body like a bandage. It also is working on even smaller pills that could be swallowed by astronauts so that NASA can track their vital signs during space travel.—By Bill Siuru PT

Beam Me Up

With a spark from a small laser, researchers from the Department of Energy's Los Alamos National Laboratory can analyze soils and rocks from more than 50 feet away. The prototype instrument they are developing for planetary exploration combines a laser the size of a small flashlight, optics, and a spectral analyzer into a compact, low-power package.

Laser-induced breakdown spectroscopy (LIBS) technology has been under development at Los Alamos for 18 years, but up to now has been applied to Earth-based purposes. It has been field tested for elemental analysis of

rocks, soils, gases, and airborne aerosol particles. A private company is developing a field-portable LIBS unit for mining and environmental monitoring applications.

LIBS works by firing a brief, intense laser pulse at the surface of an object. The laser heats and vaporizes a small spot—about as wide as a pencil eraser—on the surface. A small telescope co-mounted with the laser captures light from the glowing vapor and feeds it into the spectral analyzer. Elements create unique spectral signatures that signal their presence; with correct calibration, the intensity of the emissions reveals the relative abundance of the elements.

"We can fire the laser every five seconds and within three minutes get enough data for an accurate measurement," said Los Alamos' David Cremers, principal investigator on the NASA-funded development effort. "The scientific returns for planetary exploration increases dramatically when you can conduct such rapid analyses."

The LIBS technique could be especially useful for planetary exploration because of its ability to conduct analyses at a distance. A rover would not have to cross hazardous terrain to sample important rocks or strata. LIBS could reach up to cliff faces or across craters or peek inside cracks and crevices. The laser also can blast through the weathered veneer on a rock and reveal the true composition hidden beneath.

Cremers and his colleagues have shown in lab tests that they can get accurate measurements for a variety of key elements from a sample some 60 feet away, and they expect the technique would be even more effective in the thin atmosphere of Mars.

The end product of the three-year, \$1.1 million development effort will be a prototype LIBS instrument for field tests in the Mojave Desert. A flight model of the instrument would require additional development work to reduce the instrument's size and power requirements and increase its ruggedness.

In a related effort, a Los Alamos team led by Roger Wiens is combining a laser and a mass spectrometer to conduct standoff analyses of asteroids or other airless bodies. In LIMS, or laser ionization mass spectrometry, the laser ablates material from the surface of an object;

and the freed, ionized atoms enter a mass spectrometer, which can provide compositional measurements based on the mass of an ion. The LIMS and LIBS techniques are complementary, and both can use the same laser to ablate a sample for analysis.

"Our intention through this effort is to come up with an instrument that eventually could be incorporated into a lander craft for the moon, an asteroid, or an outer solar system body," Wiens said. PT

The Missing Link

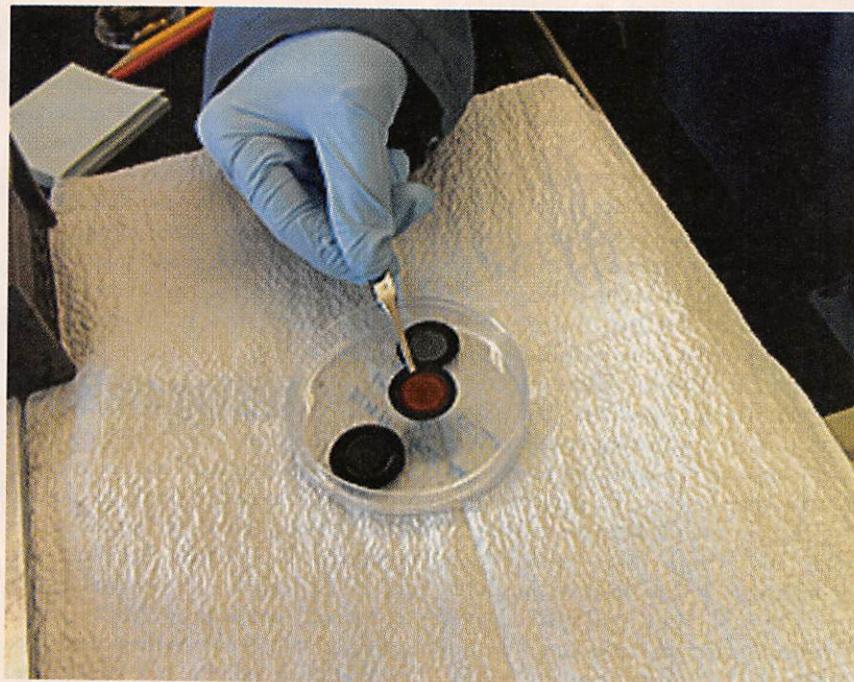
A society in which products truly "think and link" has come closer to reality. Motorola recently announced a \$5 million grant to establish the Motorola DigitalDNA Laboratory in the MIT Media Lab in Cambridge.

"Smart" products, which anticipate and meet the needs of their users, are proliferating rapidly but cannot yet communicate with each other. The Laboratory will focus on actually linking these smart products, such as set-top TV boxes, automobiles, household appliances, personal digital assistants, and wireless communications systems. Instead of having independent gadgets and appliances, the goal is to develop a seamless society of intelligent mechanisms. For example, phones won't ring; they'll behave like well-mannered English butlers—knowing when and when not to interrupt you—with the full understanding of who's calling and maybe even why, according to Nicholas Negroponte, director and co-founder of the MIT Media Lab.

The grant combines major business and education resources for the purpose of developing leading edge embedded systems, software, architecture, and applications. The partnership between Motorola and MIT also increases opportunities for researchers at both organizations to actively collaborate on developing new, practical applications for embedded systems technology. PT

Ultracapacitors Charge Ahead

Building upon an existing research patent in conducting polymers, Los Alamos scientists have created a new single-cell ultracapacitor with high-



HERE ARE THE COMPONENTS of the Los Alamos ultracapacitor prototype.

energy density—meaning it can hold a lot of energy in a small volume. The prototype ultracapacitor, a small paper-thin disk the size of a dime, contains microscopic carbon filters specially coated to act as charge-storage material. The ultracapacitor was created by electroplating a unique conducting polymer material onto the carbon filters, covering the active material with a porous separator, and adding electrolytic solution before sealing the device. It has the ability to deliver millions of discharge cycles.

According to Shimshon Gottesfeld, leader of the research team, "This is a very exciting advancement for us. Achieving 2.7 million charge/discharge

cycles is a leap forward in the development of this new generation of ultracapacitors. I'd say we're well on our way to developing a product that has significant commercial value."

In one sense, ultracapacitors lie somewhere between a battery and a capacitor. Conventional batteries provide stored energy for extended periods of time, but have peak-power and cycling limitations. Because of chemical reactions that occur within the battery, they have limited ability to charge and discharge energy repeatedly and quickly.

Conventional capacitors are capable of repeatedly providing high levels of power, but can hold very little energy. As a result, they often cannot discharge this power for more than a few microseconds.

Ultracapacitors store high levels of energy in a small volume and then release that energy in power bursts. In an automobile application, for example, a vehicle might use this burst of power to accelerate or climb a hill. Because ultracapacitors move electrical charges between conducting materials, rather than perform any chemistry, they maintain an ability to cycle far longer than batteries. Ultracapacitors, by design, are lighter and smaller than batteries with comparable peak-power levels.

According to Steven Shi, a member

of the research team, "In many applications, ultracapacitors are superior to both batteries and conventional capacitors. You can cycle (recharge) them millions of times without any loss of performance. Because there's no chemical reaction, they don't deteriorate and you'll probably rarely need to replace them."

The advantage of the Los Alamos ultracapacitor over other ultracapacitors currently in development or on the market is its large surface area, achieved while maintaining an open structure that allows for shuttling of ions. This open structure combined with high surface area allows for higher electronic and ionic connectivity between the active material and the electrolyte.

PT

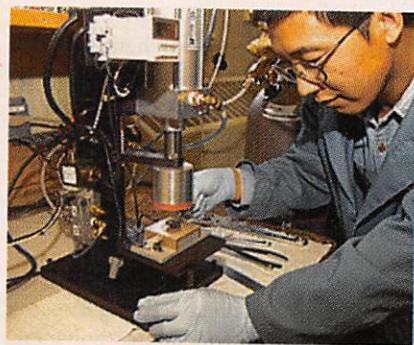
FAST On-The-Spot Training

Factory workers faced with unfamiliar tasks may soon be able to get the information they need to complete the job thanks to an electronic performance support system that provides "just in time" training whenever it is needed.

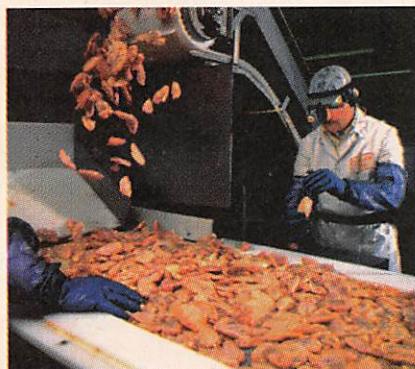
Known as Factory Automation Support Technology (FAST), the prototype system uses job performance support software, wireless communication, and a wearable computer that operates hands-free. Researchers at the Georgia Tech Research Institute (GTRI) have created two FAST applications for the poultry industry, though the system has applications in other industrial sectors as well.

"FAST is intended to support mobile employees as they perform a job, rather than train them before," said Chris Thompson, a senior research engineer.

The basic FAST hardware, which is undergoing a fourth generation of design, includes: a credit-card-sized computer and wireless-communication system worn on the belt, allowing portability and transmission of data in real time to other computer systems; a visor worn like safety glasses to display computer information to the user via a miniaturized display; earphones for listening to auditory information provided by the computer; a microphone to allow voice-activated, hands-free operation of



RESEARCHER STEVEN SHI is doing the final assembly of the ultracapacitor prototype.



A POULTRY PLANT WORKER uses the FAST prototype system to collect quality assurance data.

the computer; and flexible eight-hour battery packs worn on the belt.

"We faced two challenges in designing the hardware system," Thompson said. "We had to make the wearable computer as small as possible to be comfortable for users. And robust voice recognition required a lot of processing power, which in turn necessitates a large battery. We are still working on these issues. The fourth generation of the system will greatly increase our processing power, while the flexible battery belt will allow an operator to work an entire shift without recharging."

On the software side of FAST, the design team encountered problems with their voice-recognition software because of high ambient noise in factories. So they limited the vocabulary needed to give commands to the system and used noise-canceling microphones.

Creating information databases for the poultry-plant applications of FAST also challenged researchers. Typical information databases include: reference information about a job task or closely related set of tasks; just-in-time, task-specific training; expert advice about a job task; advice on how to use the performance support system effectively; application-help functions; and automated tools for task performance.

FAST applications, which have been briefly field tested, help poultry-plant personnel collect quality-assurance data. The application now under development will collect data for USDA regulatory compliance requirements. The projects are a partnership between GTRI, the state of Georgia, and the Georgia poultry industry.

"In our field tests, employees have been very excited by the FAST system," Thompson said. "There's a 'cool' factor to it."

PT

Data from the satellite will come to the Los Alamos Data Process Analysis Center for analysis, and from there will be distributed to the various users for each type of information. With uses ranging from remote sensing of DOE installations and other cooperative installations in the US, to climate and vegetation monitoring, the satellite has its own MTI Users Group, with more than 100 members representing varied military and civilian agencies, including the Air Force, Navy, Army, NASA, the National Oceanic and Atmospheric Administration, and universities.

The satellite, scheduled to be launched into a low-earth orbit October 31 of this year from Vandenberg Air Force Base, has been undergoing instrument calibration at the Lab's advanced optical and infrared calibration facility, a multi-user resource used by researchers nationwide from a wide variety of fields.

The initial Los Alamos task was to provide a ground calibration with sophisticated standard light and infrared sources, as well as calibrating MTI's own on-board light and IR sources, ensuring that the spectral imaging hardware operates at peak performance for its three-year planned mission. Any degradation of the on-board equipment will be detected, measured, and corrected for if the system is operating at its most effective.

The Los Alamos calibration facility is unique in offering state-of-the-art calibration from blue visible light through the long-wave infrared in a single system. The calibration sources for this project were developed in collaboration with the National Institute of Standards and Technology (NIST), and they were calibrated directly at the NIST laboratories. Using a specially developed thermal vacuum tank and liquid nitrogen cooling at -320°F, researchers were able to simulate the frozen, airless conditions of space, perfecting the satellite's ability to take accurate measurements during the MTI flight. Following the joint development with NIST of the highly accurate infrared source for this project, NIST adopted its design and will use it in the new NIST advanced calibration facility in Gaithersburg, MD.

"The accuracy we're achieving here is pushing the state of the art," according to Steve Bender, calibration team leader. PT

Eyes In the Sky

A new satellite instrument was recently rolled out of its calibration vacuum tank after almost five months of pre-launch instrument calibration work at Los Alamos National Laboratory. The Multispectral Thermal Imager (MTI) carries instruments designed to provide unprecedented levels of accurate information across 15 spectral bands (colors), only three of which are visible to the human eye. The non-visible, infrared (IR) spectral bands will allow researchers to measure the atmosphere between the ground scene and the satellite and also look for more subtle attributes of the scene. Specific science tasks will include analyzing surface temperatures, water quality, and even vegetation health.

To gather its image data, MTI looks through a 36cm aperture and uses a bank of three sensor chip assemblies, each carrying 15 arrays of detectors. The arrays contain either 208 or 832 pixels, providing MTI with nearly 17,000 tiny detectors, each no larger than the period at the end of this sentence. The 510-pound instrument is designed to be self-correcting in its data gathering, adjusting for the effects of clouds, water vapor, and airborne particles present in each image of the ground.

One enormous advantage of these arrays is that they see far beyond the visible wavelength, providing researchers with a depth and complexity of data not available through simple visible-light photography. A standard photograph of a section of light-colored ground, from a distance, might resemble either sand or snow, but given the additional infrared or temperature data, the difference becomes clear. Different types of terrain, vegetation, and other surface features become highly distinguishable when images in 15 different wavelengths can be obtained at the same time.

MTI is scheduled to transmit up to six stereo images during 5- to 10-minute daily downloads that would fill a modern PC's hard disk in less than a week, offering a wealth of information to its users.

Restoring a Classic Philco Cathedral

IN THE LAST COLUMN, WE CONCLUDED A DISCUSSION OF THE IMPACT, ON RADIO SET DESIGN, OF THE GREAT DEPRESSION OF THE 1930S. WITH THE ADVENT OF SUPER-EFFICIENT PENTODE TUBES AND THE INCREASE IN THE NUMBER AND SIZE OF

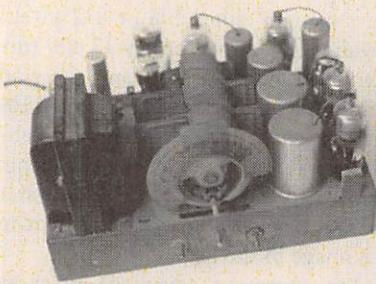
broadcast stations, it was now possible to market a very minimal radio (with as few as three tubes plus rectifier) that would deliver very satisfactory performance—at least on local stations—without an outside antenna. Many new manufacturers sprang up to market these “el cheapo” sets to the cash-starved, but entertainment-hungry, populace.

As discussed in an earlier column, Philco had a different notion of depression marketing. Their response was to produce a line of sets that, though less expensive than established models, were far from minimal. They were essentially full-featured console radios in table-model cabinets. In fact, many models were optionally available in console cabinets for those with the cash and the inclination.

The marketing concept was remarkably successful and Philco turned out the new table models by the hundreds of thousands. Because of their rounded tops and the fact that their speaker grilles are reminiscent of stained glass windows, collectors call sets of this style (by Philco and others) “cathedrals.” Arguably the most popular of the Philco cathedral models among collectors today are the Model 90; its somewhat smaller, but visually almost identical, Model 70; and the somewhat less well known Model 21. With cabinets by master industrial designer Edward L. Combs, these radios are true classics.

Though a Combs cathedral can be

pricy, it is an item well worth pursuing. In fact, I’d say that no representative collection of American broadcast sets would be complete without one! I’ve been saving a Model 70 for some time to restore for the column, and it looks like the time has come!



THE PHILCO 70 AS RECEIVED. For better visibility, the hooded tube shield has been removed from group of three tubes at right edge of chassis.

A Project Worthy of Frankenstein

My model 70 chassis came to me several years ago through the courtesy of a reader whose name unfortunately I no longer have. The set was cluttering up his basement and he wanted to find it a new home. Needless to say, I was very quick to take him up on his kind offer!

Now I had a chassis, but I needed a cabinet. Eventually my search led me to Norman Sandbach of the New Jersey Antique Radio Club. He was a Philco

collector and had an extra 70 cabinet to sell me. Since we were both going to attend the Antique Wireless Association Annual Conference (Rochester, NY) that year, he offered to bring it along.

Norm’s cabinet looked pretty decent, but it was missing the rear arch support. I understand this is a common problem in Philco cathedrals; the glue dries out, I suppose, and the piece falls out. The cabinet also needed a dial bezel. Thinking ahead, Norm had brought along another model 70 with an intact support, and we made a tracing for my use in cutting out a replacement piece. He also introduced me to a few other members of the NJARC who provided additional help with the project.

I believe it was Tony Flanagan (since a silent key), president of the club, who provided me with the missing dial bezel. He stripped it right off a Model 70 console cabinet that he had on his truck! I also met Joe Milano, who showed me some of the amazing refinishing work he had done on Philco cabinets. Joe was patient enough to explain his techniques slowly so I could take some good notes.

I still remember with pleasure Norm’s whirlwind introductions to the various NJARC guys and the generosity and good fellowship with which they shared their parts and expertise! Now the time has finally come to put all of this together and, hopefully, come up with a complete, attractive and nicely-operating Model 70. I do feel a little bit like Baron Frankenstein, though, as I contemplate assembling a finished unit using the parts of so many deceased sets!

Taking Stock of the 70 Chassis

My Model 70 chassis is quite possibly the cleanest set I have ever worked on. Though it has a light coating of dust



HERE'S THE CABINET I was fortunate enough to purchase from Norm Sandbach of the New Jersey Antique Radio Club. The missing rear arch support is now on order.

(probably from its long stay in my own basement), there is a total absence of that gummy dirt that so often must be cleaned from tubes and other components as the first step in a restoration. There is hardly a trace of corrosion above or below the chassis, and the anodized finish is completely intact, except for an area around the base of the power transformer where some material had apparently oozed out at one time.

This material can be scraped off with a fingernail, but unfortunately it seems to take the finish with it, showing the bare steel beneath. It may be that the transformer did overheat at one time and lose some wax or other compound. I noted that the original electrolytic caps had been replaced, and it may be that the originals had shorted and caused this problem.

Studying the underside of the chassis carefully, I could find no other sign of overheating or other destructive problems. The paint on all of the charming old-style "body-end-dot" coded resistors was still bright, and I saw no signs of arcing or smoke. There are a few rubber-covered wires with brittle and cracked insulation, and these will have to be replaced, of course.

As many of you know, all of the paper capacitors in Philcos of this vintage are potted inside bakelite blocks, with their leads internally connected to solder lugs that are used to make connections to the rest of the circuitry. Comparing my chassis with the pictorial diagram of the set in the *Rider's Manual*, I noted that all six of the original blocks are still

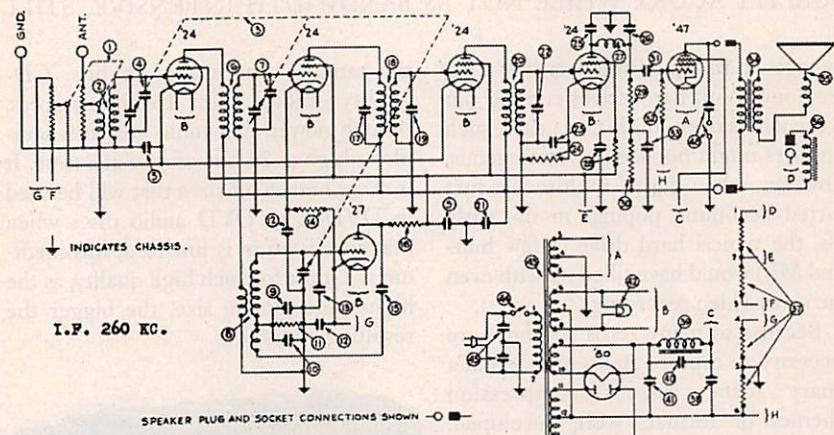
installed, though one was bridged with a couple of external paper caps—perhaps to replace open-circuited ones inside.

A comparison with *Rider's* also revealed that my set, being the earlier of the two Model 70 variations, lacks AVC, and it controls volume at the front end of the receiver rather than in the conventional manner at the detector stage. The tube lineup of this set is: RF amplifier, mixer, IF amplifier, detector—all type 24; local oscillator—type 27; audio output—type 47; rectifier—type 80. See my final *Popular Electronics* column (May, 1999) for a more complete discussion of the Model 70 and Model 90 variations.

Next, as I usually do in the early stages of examining a new radio, I pulled the rectifier tube (the usual type 80), plugged in the set, and turned it on. With the rectifier tube out, of course,

Bintiff's comprehensive book *The Radio Collector's Guide to Philco Bakelite Block Condensers*, which showed the block wiring hookups as well as the values of the caps (and, in one case, a resistor) installed within. Ray's excellent source is still in print and available from most dealers who stock books for radio collectors.

At first, the original values of the electrolytic caps in the power supply were a mystery because the *Rider's* schematic offered only parts numbers. However, the mystery was solved soon after I logged onto my friend Chuck Schwark's web page (<http://members.aol.com/caschark/index.htm>). In his very well organized "Philco Repair Bench" section, Chuck has assembled an impressive amount of information for Philco restorers. One section untangles the parts numbers, and I shortly discov-



THE 70's CIRCUIT is a conventional superheterodyne with type 24s as RF amplifier, mixer, IF amplifier and detector; a type 27 oscillator; and a type 47 power amplifier. This version does not have AVC.

the set would receive no high voltage, which could wreak havoc in case of a (very likely) capacitor failure. All tube filaments glowed with normal brightness and a meter placed across the plate pins of the "80" socket showed proper high voltage. This was a relief, considering the signs already noted of an overheated power transformer.

Parts "Want List"

With the preliminary exam over, I began to itemize the parts and services I knew I'd need for the restoration. I planned to completely recap the set, of course, and that meant looking up each of the bakelite-block condensers to see what parts were inside. *Rider's* yielded the part number of each of the blocks in my set. From there I referred to Ray

ered that the original "4916" capacitors had been rated at 6 mF at 450 volts.

If I hadn't already had the Bintiff book in my possession, Chuck's site would have also yielded the information I needed about the contents of the bakelite blocks. Browsing further, I also found a graph of serial number distributions by year originally worked out by Ron Ramirez, author of the popular book *Philco Radio 1928-1942* (ISBN: 0-88740-547-9). Using it, I discovered that my chassis (#656665) had been manufactured between September and October of 1931.

Elsewhere on the site, I discovered Dick Oliver of Elkhart, IN (219-522-4516), who supplies replacement rear arches for Philco sets (\$20.00 plus \$3.00

(Continued on page 24)

Digital Audio and MP3

MULTIMEDIA FILES ARE LARGE—REALLY LARGE. A HALF-HOUR OF FULL-MOTION, FULL-SCREEN VIDEO COULD CONSUME OVER A GIGABYTE OF STORAGE SPACE. CD-QUALITY AUDIO, WHILE NOT AS BANDWIDTH INTENSIVE, STILL

manages to fill up a little over half a gig per hour. With hard drives coming out in capacities over 20GB these days, such numbers might not seem so outrageous. However, when digital multimedia first started becoming popular in the early 90s, the typical hard drive (a few hundred MB) would have filled up with even one short video recording.

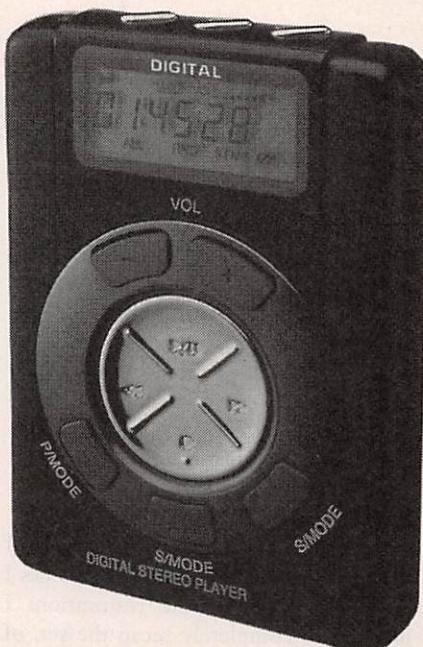
Because so many zeros and ones are necessary to capture audio or video in a binary form, various compression schemes or formats were developed. The most popular of these was created by the Moving Picture Experts Group (MPEG), and each version bears this organization's name. In the realm of encoding or compressing video, the two most common are MPEG-1 and MPEG-2, used for CD-ROM- and DVD-quality applications, respectively. These formats are a topic for another time. For now, we'll be examining the compression used for audio and its surprising recent effects on the Internet and the music industry.

Digital-Audio Basics

The phrase *digital audio* covers any aspect of sound processing or recording where waveforms are converted into a digital format or file. To accomplish this conversion, a process called sampling is used.

Sampling occurs when an analog-to-digital converter (ADC) captures "samples" of an audio waveform. The size of

the sample is measured in bits. CD-quality audio uses 16-bit samples, though newer, pro audio gear can sample as high as 24 bits of data at a time. It is these higher bit sizes that will be used in DVD-A or DVD audio discs when that specification is finalized; this medium is a must for such high quality, as the higher the sample size, the bigger the resulting audio files.



THE FIRST PORTABLE MP3 player still seems to be the best. Diamond's Rio PMP300 can hold 60 minutes of audio and will run for 12 hours on a single AA battery.

How often an ADC samples a waveform is measured in kHz and is known as the sample rate. To get CD quality, an ADC has to sample at 44.1 kHz, or 44,100 times a second. Having just mentioned the coming DVD-A spec, we might as well note that it will use 96 kHz. Like the bit size, the higher the sample rate, the larger the resulting audio.

Consider the two aspects of digital audio for a moment. Obviously, the higher the values of each, the better the quality. The more often you sample a waveform and the larger the size of those samples, the more accurately you can recreate sound. While DVD-A is on the way and provides ultra-realistic music with surround channels, for the rest of our discussion we'll use CD sampling as our base value for audio files.

Uncompressed CD audio requires a bandwidth of 1.5 megabits per second (Mbps). That means every eight seconds of CD audio will take up 1.5MB of storage (remember, eight bits make up a byte). To make it possible to easily store or transmit these files, it's clear that compression is needed.

MPEG Audio

Everything in the computer biz comes about in stages. Granted, lately it seems like these advances are happening at a soaring rate but, still, most technologies evolve linearly. That too is the case with MPEG audio.

The first MPEG scheme used to encode sound was called Layer 1. Using its 1:4 compression format, CD-quality audio could be had with a 384-kilobits-per-second (Kbps) bandwidth. It was a large improvement over the uncompressed 1.5-Mbps rate, but still resulted in large file sizes. Layer 1 was used in

Philips's Digital Compact Cassette (DCC) ... remember that techno dinosaur?

As you might have guessed, the second MPEG scheme was called Layer 2. Twice as efficient as its predecessor, Layer 2 has a 1:8 compression, with a 192-Kbps bandwidth. Its most common use was in digital radio stations, where the standard is also known as MUSICAM. The relatively small file sizes of Layer 2 also became popular with Internet users, and for the first time, manageable, CD-quality files began appearing, saved in the .MP2 format.

The popularity of compressed audio exploded, however, with the introduction of Layer 3 or MP3 format. With a 1:12 compression, and minimum rate of 128 Kbps, MP3 made it possible to store about a minute of high-quality stereo audio in a megabyte. If you have 650MB of storage space free, you can store about 15 hours of music.

An interesting facet of Layer 3 is that you can increase the bit rate, say to 160 Kbps, to get even better quality. Except for that last variable rate capability, all MPEG Layer compressions work in a similar fashion. An MPEG encoder (usually software) takes a digital audio file and analyzes the frequencies that make it up. The encoder then removes the frequencies that the human ear cannot detect and stacks the remaining data in a new file. Layer 3 takes this process a step further by removing quiet tones that are similar to louder ones (*i.e.*, the softer ones won't be heard anyway) and by encoding repetitive patterns fewer times to save space.

To play back one of these MPEG audio files you naturally need a decoder, either software or hardware. The former are tiny apps that you can load onto your computer from the Internet; the latter are portable players that have appeared on the market in the past few months. Let's look at both types.

Software Encoding/Decoding

The great majority of people enjoying the benefits of MP3 files are doing so exclusively on their PCs or Macs. Pentium-class and better machines can easily handle the task of encoding or decoding Layer 3 audio. The only other thing that's needed is the right software for the job.

First you'll need a way to get digital audio into your computer. You used to have to first use a "ripper"—which

essentially copies all the songs off a CD (which you put in your ROM drive) and saves them as .WAV files—and then an encoder. Now, though, you can encode directly from CD using an innovative program, MusicMatch's *Jukebox*. It will even let you play the files back. This is shareware and will only let you encode five songs before it expires, but a \$29.95 registration fee will get you up and running again.

For playback, though, I prefer *Winamp*, easily the best MP3 player around. This shareware program will never expire, but if you like it you really should send the company the \$10 fee. With *Winamp* you can create playlists (and even let the program randomly shuffle the tracks) and use a 10-band graphic equalizer to fine tune sound.

VENDOR INFORMATION

Diamond Multimedia Systems, Inc.

2880 Junction Avenue
San Jose, CA 95134
Tel: 408-325-7000
Web: www.diamondmm.com

MusicMatch

Web: www.musicmatch.com

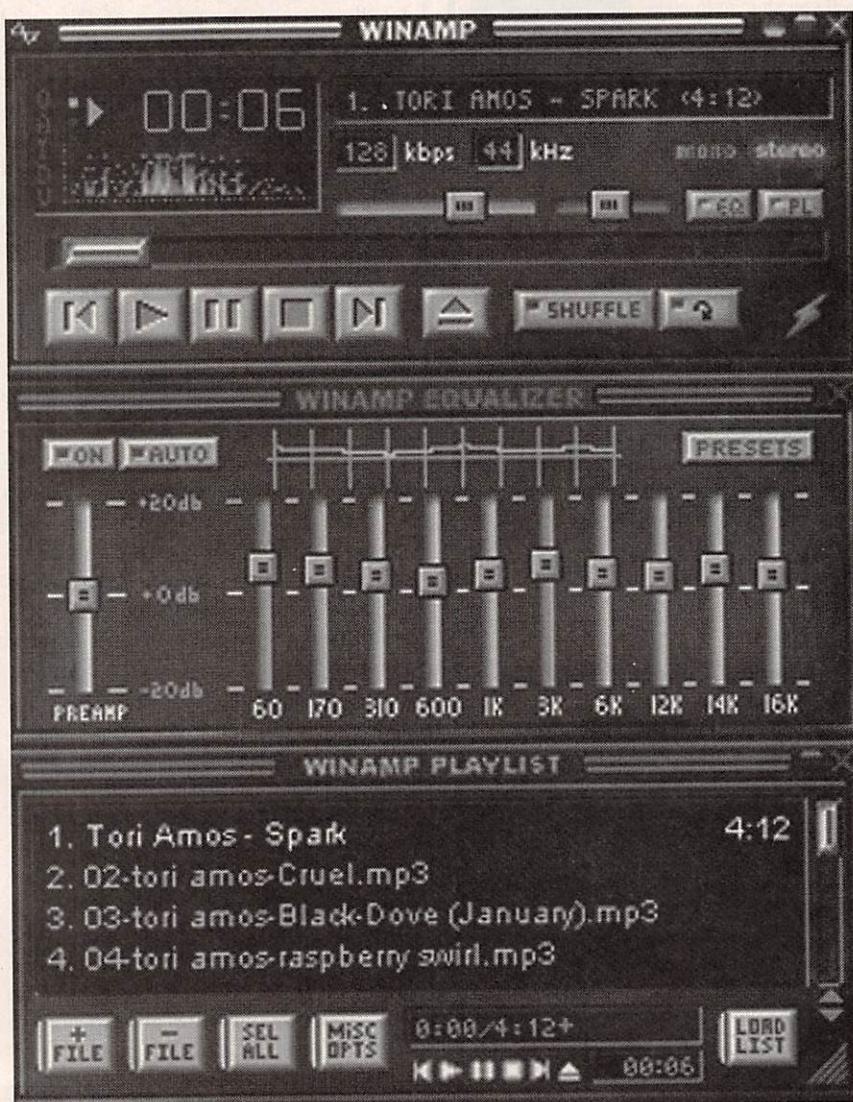
Pontis

Irrenloher Damm 17
D-92521 Schwarzenfeld
Germany
Tel: +49 (9435) 54 07-0
Web: www.mplayer3.com

Winamp

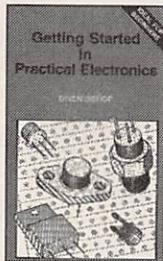
Web: www.winamp.com

The EQ's great for computers with no bass and treble control.



WINAMP IS A SHAREWARE PROGRAM that will reproduce with crystal quality any .MP3 files you get onto your PC's hard drive. With its wideband EQ and intuitive playlist creator, *Winamp* has become quite popular.

You can Build Gadgets! Here are 3 reasons why!



BP345—GETTING STARTED IN PRACTICAL ELECTRONICS ... \$6.99

If you are looking into launching an exciting hobby activity, this text provides minimum essentials for the builder and 30 easy-to-build fun projects every experimenter should toy with. Printed-circuit board designs are included to give your project a professional appearance.

BP349—PRACTICAL OPTO-ELECTRONIC PROJECTS \$6.99

If you shun opto-electronic projects for lack of knowledge, this is the book for you. A bit of introductory theory comes first and then a number of practical projects which utilize a range of opto devices, from a filament bulb to modern infrared sensors and emitters—all are easy to build.



Practical Electronic Music Projects



BP363—PRACTICAL ELECTRONIC MUSIC PROJECTS \$6.99

The text contains a goodly number of practical music projects most often requested by musicians. All the projects are relatively low-in-cost to build and all use standard, readily available components that you can buy. The project categories are guitar, general music and MIDI.

Mail to:

Electronic Technology Today, Inc.
P.O. Box 240
Massapequa Park, NY 11762-0240

Shipping Charges in USA & Canada

\$0.01 to \$5.00.....	\$2.00	\$30.01 to \$40.00.....	\$6.00
\$5.01 to \$10.00.....	\$3.00	\$40.01 to \$50.00.....	\$7.00
\$10.01 to \$20.00.....	\$4.00	\$50.01 and above.....	\$8.50
\$20.01 to \$30.00.....	\$5.00		

Sorry, no orders accepted outside of USA and Canada. All payments must be in U.S. funds only.

Number of books ordered.

Total price of books..... \$
Shipping (see chart)..... \$
Subtotal..... \$
Sales Tax (NYS only)..... \$
Total enclosed..... \$

Name _____

Address _____

City _____ State _____ ZIP _____

Please allow 6-8 weeks for delivery. ET03



PONTIS, A GERMAN COMPANY, recently announced its entry into the portable MP3 market. Called the MPlayer3, the device lets users download files to Multi-MediaCards or insert ROS prerecorded music cards.

Portable Players

Last year the music business was in an uproar, with key companies trying to legally prevent the release of Diamond Multimedia's first US portable MP3 player, the Rio PMP300. Of course, the legal battle fell apart, analogous to record companies trying to prevent the sale of tape recorders. It was decided that the real legal offenders are those who post music they don't own the copyrights to (more on that later).

The Rio is an amazing little device. Weighing 2.4 ounces and fitting in the palm of your hand, it contains 32MB of memory (and a Flash memory slot for more) that will let you store about half an hour of CD-quality music, or an hour of radio-quality tunes (you can adjust the bit rate). With no moving parts, the Rio will operate skip-free for 12 hours on a single AA battery. If you're planning on getting one, don't invest in Jukebox—it's included. The Rio retails for \$199.

A cheaper player (\$159) just entered the market from the German company Pontis. Called the MPlayer3, the device uses Multi-MediaCards to store audio. The MPlayer3 comes with two slots, each filled with an 8MB MultiMediaCard, so it offers only half the base storage of the Rio. By the time you read this, 32MB cards should be available as add-ons, with capacities as high as 128MB expected soon. The MPlayer3 also uses ROS prerecorded music cards—a non-erasable format on which record companies are expected to release tracks and albums.

With either of the above players you are a little limited by the fact that you'll have to invest in extra memory to get real long-term listening on-the-go. However, it's a step in a great direction.

With memory only getting cheaper, portable MPEG-audio players are going to be a hot product in the coming years.

Are MP3s Legal?

As we hinted at earlier, the vast majority of MP3 files on the Net are illegal copyright violations. In other words, people encode store-bought CDs and post them for all to enjoy. For legal reasons we can't recommend any sites that will help you take part in such copyright infringement. We can only say that there are plenty of Web sites and Usenet newsgroups dedicated to the posting of MP3s.

If you want to get MP3s legally, and don't want to make your own, you have a couple of options. First, visit a site like www.mp3.com that offers free songs from upcoming artists, or download free MP3s offered by record companies. Some offer only clips, some provide complete songs or even tracks that were recorded purely for the Net.

That about wraps it up for this month. As usual, if you'd like to get in touch with any comments or questions feel free to send e-mail to connections@gernsback.com, or snail-mail to *Computer Connections, Electronics Now, 500 Bi-County Blvd., Farmingdale, NY 11735.*

EN

ANTIQUE RADIO

(continued from page 21)

shipping). With that information in hand, my plans for making my own arch using the tracing from Norm's set quickly evaporated! (Yes, I have a definite lazy streak—maybe "aversion" would be a better word—when it comes to woodworking or refinishing projects!)

As this column goes to press, I'll also be ordering the required parts so that I'll have the opportunity to carry the Philco 70 project far enough along to have a progress report next time.

EN

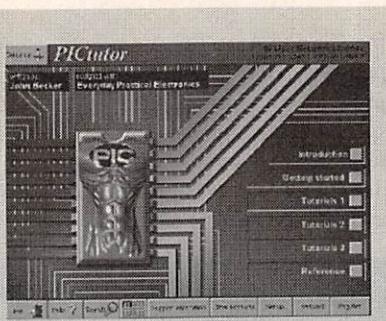




EQUIPMENT REPORT

MATRIX MULTIMEDIA PICTUTOR CD-ROM

This PIC training package teaches you how to develop code for PICs and lets you program and control a working PIC from your PC.



PICs, or Programmable Integrated Circuits, are unique little microcontrollers that are used in all types of circuitry. Their economy and scale is perfect for controlling circuits that are not too involved. Most readers of this magazine are probably familiar with PICs to some extent, but it can never hurt to know more. This Equipment Report details *PICTutor*, a CD-ROM/PIC trainer-board bundle—from Great Britain's Matrix Multimedia—that provides you with everything you need to write code for and operate a programmable PIC16C84 microcontroller.

Multimedia CD-ROMs make for great tutors in most subjects because they can contain multiple types of media and take users through different sections at the pace they are comfortable with. CD-ROMs also make it a simple matter to go back to a certain section or to search for a particular topic or item. The Matrix Multimedia's *PICTutor* CD-ROM is no exception. It contains all the theory, software, and sample material you need to program a PIC. The disc even contains sample files that can be downloaded directly to the PIC16C84 microcontroller board through your PC's parallel port.

PICTutor

PICTutor is easy to benefit from. Not only can you brush up on the theory behind PIC circuitry, but you can also use *PICTutor* to help develop code for your own PIC microcontroller-based projects. *PICTutor* is useful for students,

technicians, engineers, teachers, and the like.

The *PICTutor* software is easy to install, and you don't need a high-end PC to run it. System requirements include an IBM compatible 486/25MHz PC as a minimum, with a CD-ROM drive, VGA graphics with 256 colors, 8MB of RAM, about 10MB of hard disk space, a mouse, and Windows 3.1 or Windows 95/98. A sound card is not required.

Anyone familiar with basic Windows programs will have no trouble navigating the *PICTutor* software. Various menus take the user to different sections of the disc. One must also be comfortable using DOS to a certain extent because the software that writes PIC code and downloads it to the PIC circuit board runs in DOS.

The fully assembled *PICTutor* training board is easy to hook up and use. It runs off a DC power supply and connects to a PC through the parallel port. While the *PICTutor* CD-ROM and trainer board are no substitute for a college degree or good old hands-on field experience, the bundle is a good place to start your self-education. And *PICTutor* does provide both PIC theory and hands-on programming activities.

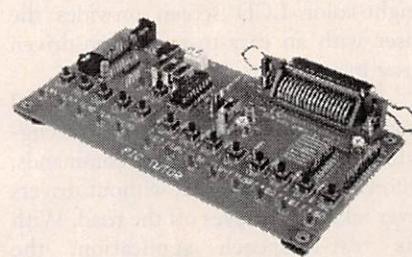
The *PICTutor* CD-ROM teaches you how to write machine code to run PIC microcontrollers. The CD-ROM features 39 tutorial sections that cover PIC architecture, commands, and programming. Advanced programming techniques are also discussed, and examples

of watchdog timers, interrupts, sleep modes, and more are provided.

Over 80 exercises featured in *PICTutor* interactively test the user, and an on-screen "virtual PIC" lets you write and test programs without touching any actual circuitry. *PICTutor* includes more than 30 working example programs and a shareware assembler. The tutorials have you modify some PIC assembly files and write your own command sets. Various messages will prompt you should you make an error.

The PIC training board can be used with or without the *PICTutor* CD-ROM. The fully assembled board houses a programmable PIC16C84 microcontroller along with switches, LEDs, and other circuitry that support the PIC. The PIC board connects to a PC through the parallel port using a standard Centronics printer. The board requires a 12- to 14-volt DC power supply, and a battery holder for eight AA cells is provided. The board can be upgraded to drive a quad 7-segment display and intelligent alphanumeric display.

A word processor or text editor is used to edit and create .ASM files for assembly through TASM, the shareware assembler included on the *PICTutor* CD-ROM. The disc also contains TASM documentation and the demonstration files used in the *PICTutor* tutorials. Demo files are supplied as ASCII text files with a .ASM extension and as assembled object code files with a .OBJ



THIS FULLY ASSEMBLED PIC programmer is included in the *PICTutor* bundle.

(Continued on page 29)

NEW PRODUCTS

USE THE FREE INFORMATION CARD FOR FAST RESPONSE

In Dash PC

THE CLARION AUTOPC INTEGRATES car audio, computing functions, navigation, and wireless communications into a 1-DIN unit in a car's dashboard. It is a high-powered AM/FM stereo with integrated digital stereo processing (DSP) equalization and a built-

the Clarion Auto PC comes with a basic point-to-point navigation system that provides route calculations from a user-specified starting location and destination, as well as accurate turn-by-turn directions. Other built-in applications include an address book, mileage log,



CIRCLE 20 ON FREE INFORMATION CARD

in 35-watt \times 4-channel amplifier. In addition, Windows CE, Hitachi SH3 processor, and 8MB DRAM/8 MB ROM are all included with the system. The unit features the first ever in-dash USB CD audio and CD-ROM drive, which supports an optional six-disc CD/CD-ROM changer. The backlit, eight-color LCD screen provides the user with an easy-to-read, icon-driven user interface.

Designed with safety, efficiency, and convenience in mind, the unit recognizes over 200 simple voice commands, allowing use of the unit without drivers ever taking their eyes off the road. With its text-to-speech application, the Clarion AutoPC can provide status information and e-mail alerts through speech synthesis and text information presented on the unit's display.

To make finding destinations easier,

and a hands-free voice memo feature.

The AutoPC supports an optional Compact Flash Memory Card that can be used to expand the on-board memory as well as provide an interface for other products such as paging and hardware accessories. Also included is an Infrared Data Port that allows easy data exchange with a handheld PC.

The optional Global Positioning System (GPS) receiver works in conjunction with the built-in navigation system to provide automatic starting-point identification and location updates. The GPS accessory, along with the cellular-phone interface, provides access to roadside emergency services, such as receiving directions when lost and pinpointing the location of a 911 call for immediate assistance.

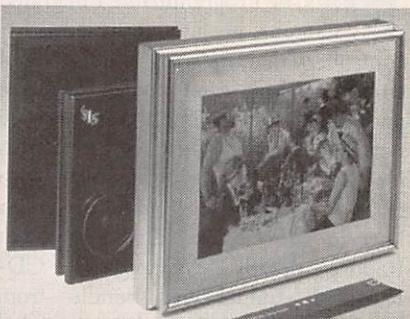
The Clarion AutoPC has a suggested retail price of \$1299.

CLARION CORPORATION OF AMERICA

661 W. Redondo Beach Blvd.
Gardena, CA 90247
Tel: 310-327-9100
Fax: 310-327-1999
Web: www.autopc.com

Flat Speakers

USING FLAT-PANEL TRANSDUCER technology, Flat Speakers provide superior sound quality in a package less than two-inches thick. These speakers can be concealed behind art to complement the



CIRCLE 21 ON FREE INFORMATION CARD

decor of any room.

A standard black or white speaker screen can be replaced with any of more than 1000 framed art prints. Art covers are printed on a synthetic silk developed specifically to display vibrant color while simultaneously maintaining auto fidelity. Speaker wires can be concealed inside a wall or optional flat speaker wire can be hidden under wallpaper.

Flat speakers are available in sets of two. Small speakers (11 \times 14 inches) are \$595. Large models (18 \times 24 inches) are \$895.

FRONTGATE

2800 Henkle Drive
Lebanon, OH 45036-8894
Tel: 800-626-6488 or 513-933-8050
Fax: 513-933-8055
Web: www.frontgate.com

DC Power Supply

THE PS402 TRIPLE OUTPUT DC Power Supply contains two 0- to 30-volt outputs with an adjustable 3-amp cur-



CIRCLE 22 ON FREE INFORMATION CARD

rent limit. The outputs can be connected in series to double the voltage. There is also a fixed 5-volt output rated at 3 amps.

The unit monitors the DC voltage or current supplied to the load, using a selectable digital display. Two front-panel LEDs indicate the "Constant Current" and "Constant Voltage" crossover point automatically, eliminating the need to constantly adjust the output voltage or current. Other features of the power supply include adjustable current limiting; single, series, or parallel operation; and low ripple and noise.

The PS402 comes with test leads and manual and has a list price of \$529.

SENCORE INC.

3200 Sencore Drive
Sioux Falls, SD 57107
Tel: 800-SENCORE or 605-339-0100
Fax: 605-339-0317
Web: www.sencore.com

Two-Way Radio

FAMILY RADIO SERVICE HELPS people keep in touch, whether in a mall, a park, or out camping. These small, colorful, two-way Family Radios provide clear reception for two miles. A license is not required to operate the radios, which are FCC registered.

The radios operate with exceptional clarity and minimal interference at an ultra-high FM frequency (462-468 MHz). They feature 14-channel electronic tuning and a two-way page function, which can be set to communicate with other GE radios or with other brands of FRS units. The LED display provides information on the radio's channel, and LED indicators show transmission and battery life.

Available in blue and orange (models GE3-5873 and GE3-5877, respectively), the Family Radio Service (FRS) units have a suggested retail price of \$69.99.



CIRCLE 23 ON FREE INFORMATION CARD

THOMSON CONSUMER ELECTRONICS

10330 N. Meridian Street
Indianapolis, IN 46290-1024
Tel: 317-587-4450
Fax: 317-587-6708
Web: www.rca-electronics.com

Toroidal Transformers

THESE LOW-PROFILE TOROIDAL power transformers are half the size and weight of conventional EI types of equal VA rating. Designed for rectifier circuitry applications, the step-down transformers are available in power ratings



CIRCLE 24 ON FREE INFORMATION CARD

from 26VA to 1000VA for the international series with 117V/234V input voltages and up to 600VA for the North American series with a single 117V/60Hz input voltage. The transformers (whose core is made from a continuous strip of M3-grade high-flux grain-oriented silicon steel wound under controlled tension) come with dual output voltages and are certified to North American and international safety standards.

Mounting hardware consists of a metal washer and two rubber pads for power ranges under 600VA. Larger transformers are supplied with an epoxy potted center with a 1/4-inch mounting hole. Other options include L-brackets for vertical mounting, termination with connectors, or supplying the transformers either fully potted or bare inside metal or plastic enclosures.

Prices for sample quantities (1-4 pieces) range from \$33.40 for the 26VA to \$109.75 for the 100VA. (Prices are slightly higher for the North American series.)

TORTTRAN, INC.

915 Pembroke Street
Bridgeport, CT 06608
Tel: 877-TORTTRAN
Web: www.torttran.com

Professional Multimeter

COMBINING A TRUE RMS MULTIMETER with a single-channel 100-kHz graphical oscilloscope, the Craftsman Professional handheld (4.2 x 8.3 x 2.2) Multimeter + Scope is ideal for household appliance testing, installation and service, electrical projects, electronic design and testing, and auto repair and tune-up. The oscilloscope provides glitch capture, pre/post trigger, and graphic LCD with a HELP mode. Among the multimeter functions are True RMS AC voltage/current, DC voltage/current, resistance, capacitance, frequency, dB, temperature (with adapter), % Duty Cycle, pulse width, period, TTL level generator, and diode and continuity tests.

Features of the meter include a built-in RS-232 interface (cable and software sold separately), minimum/maximum/average displays, 15 waveform memory, auto power off, and surge protection. The 4000-count (3 1/4-digit) multimeter display with analog bar graph also offers data-hold and over-range indication. The unit comes complete with built-in stand, six AA batteries, fuses, test leads,

(Continued on page 92)

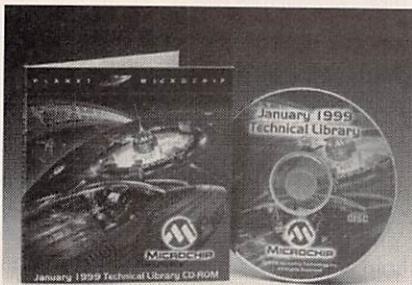
NEW LITERATURE

USE THE FREE INFORMATION CARD FOR FAST RESPONSE

The 1999 Technical Library CD-ROM

from Microchip Technology Inc.
2355 W. Chandler Blvd.
Chandler, AZ 85224-6199
Tel: 602-786-7668
Web: www.microchip.com
Free

This CD-ROM contains a complete selection of technical documentation on Microchip's PICmicro 8-bit microcontrollers, non-volatile memory devices, secure data products, and associated development tools. The CD-ROM provides an extensive collection of Microchip product specifications, application notes and related source codes, development systems, software support for embedded control applications, programming specifications, users' guides,



CIRCLE 338 ON FREE INFORMATION CARD

and more. Giving users the flexibility to edit, compile, emulate, and program PICmicro MCU devices—all from a single user interface, the library includes the most current release of the MPLAB Integrated Development Environment Software.

All documents are readable in Adobe Acrobat Portable Document Format (.pdf) and run under the included Adobe Acrobat Reader 3.0. A copy of Winzip is also provided to access very large files. In addition, hot links to the on-line Web site are established throughout the CD-ROM.

Passport to Web Radio, 2nd Edition
by Lawrence Magne, Editor
International Broadcasting Services Ltd.
Box 300

BooksNow To order books in this magazine or, any book in print. Please call anytime day or night: (800) BOOKS-NOW (266-5766) or (801) 261-1187 ask for ext. 1454 or visit on the web at <http://www.BooksNow.com/electronicsnow.htm>.

Free catalogs are not available.



CIRCLE 339 ON FREE INFORMATION CARD

Penn's Park, PA 18943
Tel: 215-598-9018 or 215-598-3298
Web: www.passport.com
\$19.95

It is now possible to hear more stations on the Web than can be heard at any location through the airwaves, while continuing to use your computer for other tasks. Listeners anywhere with Web access and a multimedia PC can hear more than 1550 stations from over 100 countries. Examples of programming that can be heard include: Radio Beethoven from Santiago, Chile; Dixieland direct from New Orleans; a Mohawk Indian radio station; bluegrass, folk, and country music from the Czech Republic; rugby from New Zealand; and Moroccan music from Casablanca. While most Webcasting stations are live, some offer on-demand programming.

In its nine entertaining chapters, the book explains how to listen to Internet broadcasts; reviews the top stations in categories from African to Vietnamese; and presents the only country-by-country, city-by-city directory of Webcasting stations. It also discusses the future of Web radio.

Internet Frauds Databook

by John J. Williams
Consumertronics
P.O. Box 23097
Albuquerque, NM 87192
Tel: 505-237-2073
Fax: 505-292-4078
Web: www.tsc-global.com
\$19

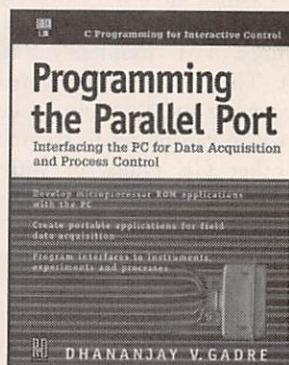
CIRCLE 340 ON FREE INFORMATION CARD

Internet cons, scams, and related frauds take in over \$2 billion annually. Most are done anonymously and with little fear of prosecution. This book discusses how and why such fraud is accomplished. Other topics covered are how to protect yourself, ways to identify a swindler, how victims are chosen, hazards of the Internet, and more.

Programming the Parallel Port

by Dhananjay V. Gadre
R & D Books
1601 W. 23rd St., Suite 200
Lawrence, KS 66046
Tel: 800-444-4881 or 785-841-1631
Fax: 785-841-2624
Web: www.rdbooks.com
\$44.95

A wealth of information for C programmers and circuit designers who are creating interfaces to control external devices that are connected to PCs through the parallel port is contained in this book. The author guides you through a detailed tour of the parallel printer port and, in a master class of



CIRCLE 341 ON FREE INFORMATION CARD

techniques and sample programs, shows you how to exploit the power and versatility of this PC feature.

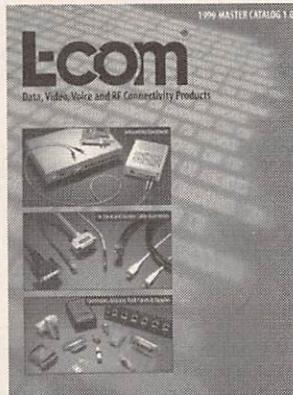
The text provides both a theoretical and practical foundation on which to build special-purpose applications. The early chapters can be used as a tutorial for educators and hobbyists looking for simple, low-cost interface solutions to replace expensive add-on cards or bus interfaces. The advanced sections help engineers working in control system design and device development, as well as those working with real-time and embedded systems.

1999 Master Catalog 1.0

from L-Com
45 Beechwood Drive
N. Andover, MA 01845-1092
Tel: 800-343-1455
Fax: 978-689-9484
Web: www.L-com.com

Free

This 144-page color catalog presents a complete guide to data, video, voice, and RF connectivity products. L-Com designs and manufactures copper and fiber cable assemblies, interconnection adaptors, connectors, and cable test equipment, as well as rack panels and



CIRCLE 342 ON FREE INFORMATION CARD

shelving. They also distribute related products, such as LANart and Unicorn Ethernet equipment; Comtran, Mohawk, and Hitachi bulk cable; Stewart modular plugs; Clauss tools; and Fotrec fiber optic testers.

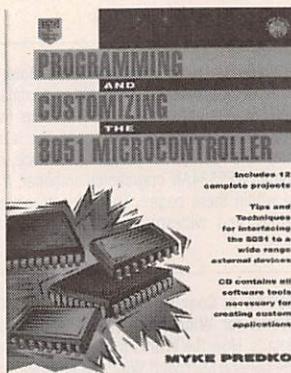
The catalog starts with a visual index of products organized by type and illustrated by color photos. It ends with two Tables of Contents, one alpha-numeric and the other organized by product. Complete pricing information is included.

Programming and Customizing the 8051 Microcontroller

by Myke Predko

McGraw Hill
1221 Avenue of the Americas
New York, NY 10020
Tel: 800-2MCGRAW
Web: www.ee.mcgraw-hill.com

\$39.95



CIRCLE 343 ON FREE INFORMATION CARD

Providing readers with a complete understanding of the 8051 chip compatibles, this tutorial/disk package includes all the information needed to design and debug tailor-made applications. It details the features of the 8051 and demonstrates how to use these embedded chips to access and control many different devices. The book shows what happens within the 8051 when an instruction is executed and demonstrates how to interface 8051s with external devices.

The volume gives readers over 30 experiments and 12 complete projects. It features full explanations of how the devices are electronically programmed. A design for building an Atmel 2010 microcontroller is also provided. The included CD-ROM contains all the software tools necessary for creating custom applications.

1999 New Product Catalog

from B&K Precision Corp.
1031 Segovia Circle
Placentia, CA 92870-7137

BooksNow To order books in this magazine or any book in print. Please call anytime day or night: (800) BOOKS-NOW (266-5766) or (801) 261-1187 ask for ext. 1454 or visit on the web at <http://www.BooksNow.com/electronic-snow.htm>.
Free catalogs are not available.

EQUIPMENT REPORT

(continued from page 25)

extension. These can be downloaded directly to the PIC16C84 microcontroller on the trainer board.

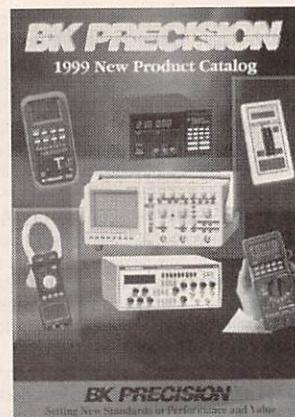
The PICtutor CD-ROM/trainer board bundle will help tutor you in PIC theory, application, and programming. You might find it useful and informative even if you have just a passing interest in PICs. And those already using PICs in their own circuits should find PICtutor to be a time saver in developing code for those projects. PICtutor lets you test your code on the trainer, before building an actual circuit.

The PICtutor CD-ROM and PIC trainer board are available as a bundle from CLAGGK Inc. (PO Box 4099, Farmingdale, NY 11735; Tel: 516-293-3751) for \$179 postpaid in the U.S. and \$184 (in U.S. funds) in Canada; NY state residents must also add sales tax. EN

Tel: 714-237-9220
Fax: 714-237-9214
Web: www.bkprecision.com

Free

The 16-page, full-color catalog features over 25 new products, including IC testers, programmable power supplies, and video monitor testers, as well as test instruments and accessories. It is an ideal source document for electronic



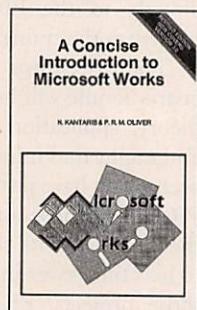
CIRCLE 344 ON FREE INFORMATION CARD

and electrical field service, depot service, and engineering/R&D personnel.

The most recent products are at the beginning. Among them are the Model 570 linear IC tester and the Model 575 digital IC tester; and the Model 1275 hand-held, battery-powered video monitor tester and Model 1280 benchtop tester. The catalog also presents selected (Continued on page 94) 29

Buyers' Budget Books Better Buys

BP294-A Concise Introduction to Microsoft Works \$6.99. In the shortest and most effective way, you can use the word processor to advantage to type, edit, print and save documents. It goes on to explain how Works can be used to build up simple spreadsheet examples, edit them, save them, print them and retrieve them. It informs you how to create simple macros, and enables you to simplify long repetitive tasks and to customize the program to your own needs.



BP349-Practical Opto-Electronic Projects \$6.99. If you shun opto-electronic projects for lack of knowledge, this is the book for you. A bit of introductory theory comes first and then a number of practical projects which utilize a range of opto devices, from a filament bulb to modern infrared sensors and emitters.

BP350-Electronic Board Games \$6.99. Twenty novel electronic board games that you can build from the plans in this book. Whether you are interested in motor racing, searching for buried treasure on a barren island or for gold in Fort Knox, spinning the wheel of fortune, or doing a musical quiz—there is something for you to build and enjoy!

BP378-45-Simple Electronic Terminal Block Projects \$6.99. Contains 45 easy-to-build electronic projects that can be built by an absolute beginner. Projects are assembled on terminal blocks using only a screwdriver and other simple hand tools. No soldering is required.

BP432-Simple Sensor Terminal Block Projects \$6.99. This book is the next logical step from *45 Simple Electronic Terminal Block Projects* (BP378), by the same author. The former describes an easy method of constructing transistor circuits without the need for soldering. It is an *open sesame* to the practical world of electronics for youngsters or beginners.

BP367-Electronic Projects for the Garden \$6.99. Electronics enters the Garden! New exciting book points out how gardeners can build simple gadgets to promote success where the elements work against you. Some of the projects are: over/under temperature monitoring, dusk/dawn switching, automatic plant watering, warming cables, etc.

BP368-Practical Electronics Musical Effect Units \$6.99. There is a constant hullabaloo for musical effects projects by the hobbyist community. This book provides practical circuits for several projects that range in complexity and are sure to work. All the circuits are easy to build and use readily-available parts.

BP385-Easy PC Interfacing \$6.99. The built-in ports in your PC provide an easy and hassle-free way of interfacing your circuits. This book provides useful PC add-on circuits including the following: Digital input/output ports; analog-to-digital and digital-to-analog converters; voltage and current measurement circuits; resistance and capacitance meters, temperature measurement interface, biofeedback monitor, and many other useful interfaces.

BP396-Electronic Hobbyists Data Book \$7.99. This book provides a wide range of data. If, for example, you require details of a modern five-band resistor code or an old color code for a ceramic capacitor, the formula for parallel resistance, or basic data on an NE5534AN operational amplifier, it is contained within these pages. The subjects covered are numerous and widespread to cover all hobbyist interests.

BP343-A Concise Introduction to Microsoft Works for Windows \$7.99. The book explains and details: How the Works for Windows package fits into the general Microsoft Windows environment; how to use the word processor to advantage; how to use Microsoft Draw to create and edit graphics and place them in your documents; how to build up simple spreadsheet examples; and how single, and multiple charts, or graphs, of different types can be generated. And there's much more!

BP282-Understanding PC Specifications \$5.99. This book explains PC specifications in detail, and the subjects covered include the following: Differences between types of PC (XT, AT, 80386, 80486, Pentium etc.); math co-processors; input devices (keyboards, mice, and digitizers); memory, including both expanded (EMS) and extended RAM; RAM disks and disk caches; floppy disk drive formats and compatibility; hard disk drives; and display adapters (CGA, Hercules, super VGA, etc.).

BP298-Concise Intro to the Macintosh System and Finder \$5.99. Although the Mac's WIMP user interface is designed to be easy to use, much of it only becomes clear when it is explained in simple terms. The book explains: The System and Finder, what they are and what they do; how to use the System and Finder to manipulate disks, files and folders; configuring and printing files from the Finder; getting the most from the system utility programs; and running MultiFinder.

BP88-How To Use OP Amps \$5.99. The Operational Amplifier is the most adaptable circuit module available to the circuit designer. It is possible to purchase a low-cost integrated circuit with several hundred components, very high gain and predictable performance. This book has been written as a designer's guide for most Operational Amplifiers, serving both as a source book of circuits and a reference book for design calculations.

BP316-Practical Electric Design Data \$7.99. A builder's bargain book—a comprehensive ready-reference manual for electronic enthusiasts with over 150 practical circuits. It covers the main kinds of components (from pig-tail leads to surface mount), pinouts, specs and type selection. Basic units are defined and most used formulae explained. Five additional sections are devoted to circuit design, covering analog, digital, display, radio and power supply circuits.

BP346-Programming in Visual Basic for Windows \$7.99. This book is a guide to programming. The reader is not expected to have any familiarity with the language as both the environment and statements are introduced and explained with the help of simple programs. The user is encouraged to build these, save them, and keep improving them as more complex language statements and commands are encountered.

BP345-Getting Started In Practical Electronics \$6.99. If you are looking into launching an exciting hobby activity, this text provides basic essentials for the builder and 30 easy-to-build fun projects with which every experimenter should toy. Printed-circuit designs are included to give your project the professional touch.

BP451-Troubleshooting Your PC Printer \$8.99. Explains the different printer types, their suitability for different tasks, the costs of running them, how to connect them and get the driver software running and, of course, what is most likely to go wrong and what you can do for yourself. Most important of all, it warns you of what you should quite definitely NOT try to do for yourself.

PCP112-Digital Electronics Projects \$10.99. Contains 12 digital electronics projects suitable for the beginner to build with the minimum of equipment—from instrumentation to home security, and a few “fun” projects too. With one exception, all projects are battery powered, and therefore, are completely safe for the beginner or young constructor.

PCP107-Digital Logic Gates and Flip-Flops \$10.99. Intended for enthusiasts, students and technicians, this book seeks to establish a firm foundation in digital electronics. It is for the user who wants to design and troubleshoot digital circuitry with full understanding of the principles. No background other than a basic knowledge of electronics is assumed.

BP76-Power Supply Projects \$3.99. Presents a number of power-supply designs including simplified unbiased types, fixed voltage-regulated types and variable voltage stabilized designs. All are low-voltage types intended for use with semiconductor circuits. Apart from presenting a variety of designs that will satisfy most applications, the data in this book should help the reader to design his own power supplies. An essential addition to the experimenters electronics library.

ELECTRONIC TECHNOLOGY TODAY INC.
P.O. BOX 240, Massapequa, NY 11762-0240

Name _____
Address _____
City _____ State _____ Zip _____

NSW1

Allow 6-8 weeks for delivery

SHIPPING CHARGES IN USA AND CANADA
\$0.01 to \$5.00.....\$2.00
\$5.01 to \$10.00.....\$3.00
\$10.01 to \$20.00.....\$4.00
\$20.01 to \$30.00.....\$5.00
\$30.01 to \$40.00.....\$6.00
\$40.01 to \$50.00.....\$7.00

\$50.01 and above.....\$8.50

SORRY No orders accepted outside of USA & Canada
Total price of books
Shipping (see chart)
Subtotal
Sales Tax (NYS only)
Amount Enclosed _____

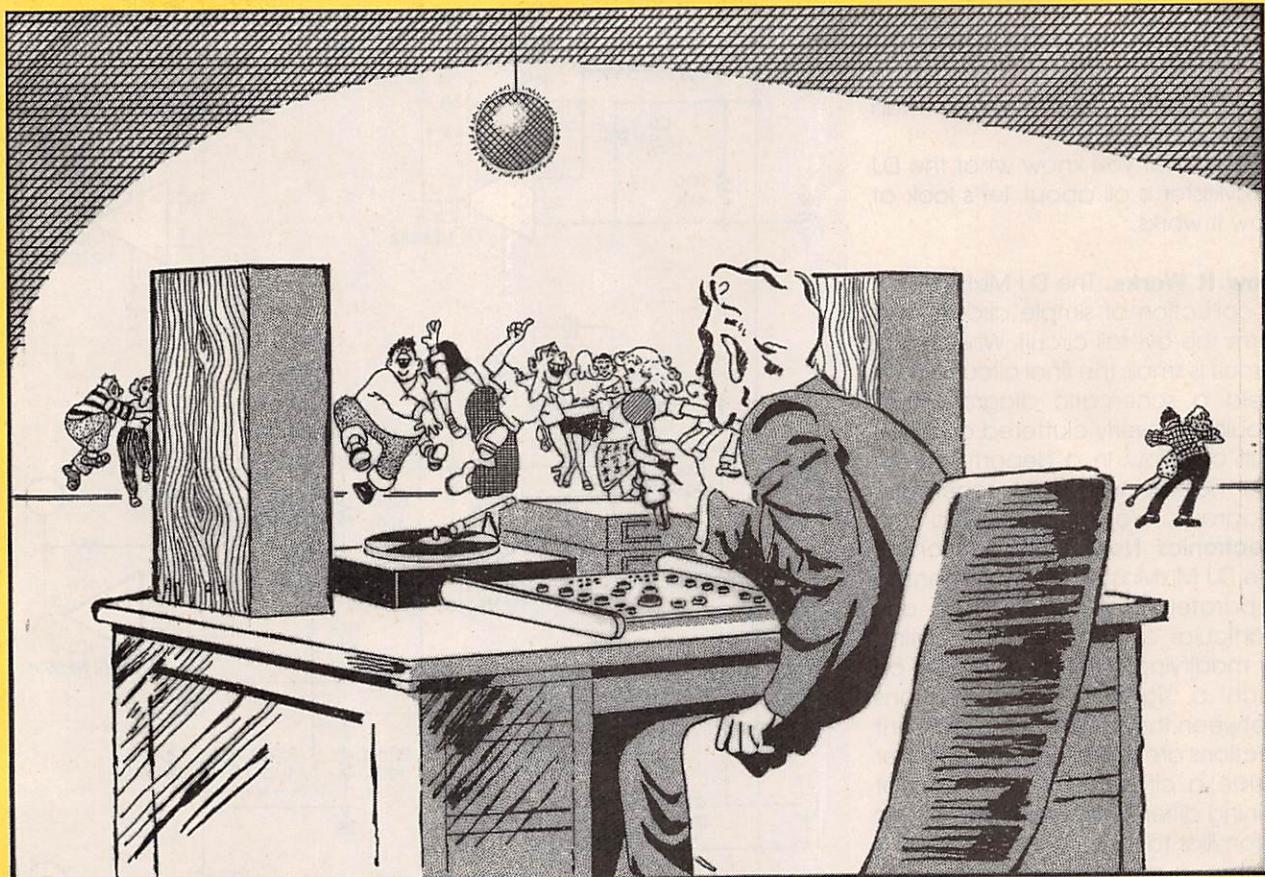
All payments must be in U.S. funds!

No. of Books Ordered _____
\$ _____
\$ _____
\$ _____
\$ _____

Become the "Life of the Party" with The DJ MixMaster

This portable mixing board is equally at home at a party, in the studio, or anywhere that you need to work with audio.

JULES RYCKEBUSCH



If, like the author, you've done much work with audio in a studio or with live sound, you've probably been asked by friends or clients at one time or another if you could do some "on-site" work at a remote location or if you could "DJ" their next party. The available DJ-mixing equipment on the market of decent quality, unfortunately, tends to be a bit on the expensive side. What's more, much of the reasonably-priced gear for the occasional "record-spinner" uses very cheap components with the resulting questionable audio performance.

Because of that, the only "acceptable" solution this author had found until recently was to lug around his 16-input console—not the most desirable of solutions. Thanks to The DJ MixMaster presented here, those days are over.

The DJ MixMaster is the result of discussions with other DJs, studio engineers, and a personal desire for a mixing console that is a high-quality, low-cost unit with the features that are desired by both professional and amateur "party-fun managers!" It's a compact yet feature-laden small mixing board.

Along with spinning tunes and being the life of the party, there are many uses for such a small DJ mixer. It can be used to put together party tapes that professionally fade from one cut to the next or as a way to practice your karoke skills. It also sports ideal audio specifications, allowing it to be used as a stand-alone phonograph pre-amp in a recording studio.

The DJ MixMaster provides several features only found on top-of-the-line DJ mixing boards. It features simultaneous access to two phonograph inputs, two line-level

inputs, a microphone input, and an auxiliary stereo line-level input. Most DJ mixers force you to switch between the phonograph and line-level inputs. The DJ MixMaster also features a stereo auxiliary-send output, which can be used to feed the audio to a sampler or a digital-effects processor; we'll look at that feature and its use later in this article. Additionally, there is a full-featured headphone monitoring section that lets you have a separate headphone mix from all of the inputs. Another useful feature is an equalizing section. Although it is a simple tone-control-like shelving EQ with only bass and treble controls, the corner frequencies are set to more musically-useful values than most DJ mixers.

Now that you know what the DJ MixMaster is all about, let's look at how it works.

How It Works. The DJ MixMaster is a collection of simple circuits that form the overall circuit. While each circuit is small, the final circuit would yield a schematic diagram that would be overly cluttered and difficult to follow. In a departure from the normal way that schematic diagrams are presented in **Electronics Now**, each section of the DJ MixMaster will be presented separately. Note that when any particular circuit is either creating or modifying a signal or acting on such a signal, the connections between the circuits of the different sections are represented by a letter inside a circle. While that style of joining different portions of a circuit is familiar to those that have seen it before, a reminder or short explanation never hurts.

At the heart of each of the DJ MixMaster circuits is an NE5532 dual op-amp. The NE5532 has excellent audio specifications and will drive a 10-volt rms signal into a 600-ohm load, giving it the ability to drive headphones with a similar rating directly. Those specifications have made the NE5532 an "unofficial" industry standard for audio use. In fact, most manufacturers of op-amps tend to compare their device to the NE5532 when discussing audio use.

Several pin-compatible op-amps

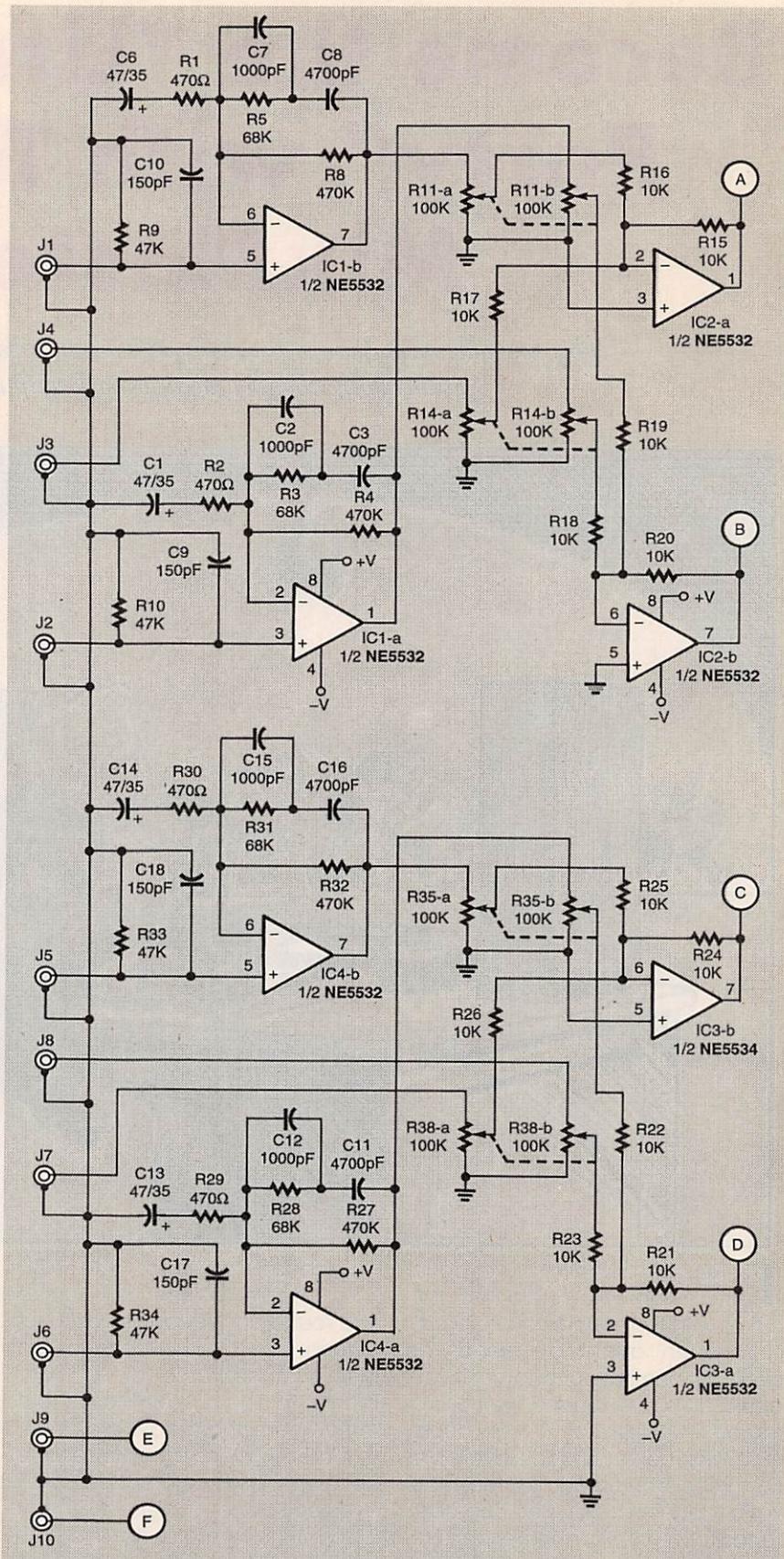


Fig. 1. The DJ MixMaster has stereo inputs for two phonograph turntables and two line-level sources such as CD players or tape decks. Each input level can be set individually. An auxiliary input designed to accept the output of an effects processor can be used as a third line-level input. The phonograph-input preamplifiers are RIAA compensated.

1 Study at Home

We live in a constantly changing world, where exciting new technological advancements are made everyday. At the Cleveland Institute of Electronics we make it simple to train, earn a degree and prosper in the workforce. Over 150,000 students in the United States and 70 foreign countries got their start in electronics through CIE. And they received their education at their own pace in the comfort and convenience of their homes. At CIE you'll receive a first class education by a faculty and staff devoted to your career advancement. All of CIE course and degree programs are taught through a patented, proven learning process. To discover all the benefits and programs/ degrees available from CIE send for your free course catalog today.



CIE's Associate Degree program contains 397 lab experiments.

2 Work Where You Want

And once you complete your education at CIE, you can just about write your own ticket to where you want to work and in what specialized field... MIS, broadcasting, industrial, automotive, management... The opportunities seem limitless in today's high-tech world.

The Cleveland Institute of Electronics has been approved for use of Veterans Affairs Benefits and DANTES Tuition Reimbursement.

Tuition assistance from the Veterans Administration or the DANTES Program is available to veterans and service members in the Armed Forces.



Employees are seeking & hiring qualified applicants.

FREE CATALOG



1776 E. 17th Street
Cleveland, Ohio 44114-3679

Visit Our Web-Site
www.cie-wc.edu

YES! I am interested.
Please send me a catalog.

Name: _____

Address: _____

City: _____ State: _____ Zip: _____

Phone Number: _____

A school of thousands. A class of one. Since 1934.

AE145

PARTS LIST FOR THE DJ MIXMASTER

SEMICONDUCTORS

IC1-IC10—NE5532 dual op-amp, integrated circuit
IC11—NJR7815 15-volt regulator, integrated circuit, see text
IC12—NJR7915 15-volt regulator, integrated circuit, 470-ohm
LED1—Light-emitting diode, red
BR1—50-volt, 1-amp, bridge rectifier

RESISTORS

(All resistors are 1/4-watt, 1%, metal-film units unless otherwise noted.)
R1, R2, R29, R30—470-ohm
R3, R5, R28, R31—68,000-ohm
R4, R8, R27, R32—470,000-ohm
R6, R7, R56-R59, R112, R113—47-ohm
R9, R10, R33, R34—47,000-ohm
R11, R14, R35, R38, R49, R51, R53, R61, R63, R88, R91, R92, R116—100,000-ohm potentiometer, panel-mount, audio taper, dual gang
R12, R13, R36, R37, R50, R52, R54, R62, R64, R66, R89, R109, R110, R115, R117—not used
R15-R26, R40-R44, R46-R48, R67, R68, R71, R72, R75, R76, R97-R104—10,000-ohm
R39, R45—100,000-ohm
R55, R60, R90—10,000-ohm potentiometer, panel-mount, audio taper
R65—10,000-ohm potentiometer, panel-mount, audio taper, dual gang
R69, R70, R74, R77-R80, R82-R85, R87—15,000-ohm

R73, R111—22,000-ohm
R81, R86—75,000-ohm
R93-R96, R105-R108—1000-ohm
R114—2200-ohm
R118, R121—33,000-ohm
R119, R120—600-ohm

CAPACITORS

C1, C6, C13, C14—47-mF, 35-WVDC, electrolytic
C2, C7, C12, C15—1000-pF, ceramic-disc
C3, C8, C11, C16—4700-pF, ceramic-disc
C4, C5—470-mF, 35-WVDC, electrolytic
C9, C10, C17, C18—150-pF, ceramic-disc
C19, C22—1000-pF, ceramic-disc
C20, C21—0.68mF, Mylar
C23, C24—47-pF, ceramic-disc
C25, C26—1200-mF, 35-WVDC, electrolytic
C27, C28—0.1-mF, ceramic-disc

ADDITIONAL PARTS AND MATERIALS

J1-J16—RCA-style phono jack
J17—Headphone jack, 1/4-inch stereo
J18—Microphone jack, XLR-style
S1, S2—Double-pole, double-throw switch
T1—Wall-mounted transformer, 24-volt AC, 1 amp
Case, wire, hardware, etc.

one section will be discussed for simplicity. The phonograph inputs from J1 and J2 go to a standard "textbook" RIAA pre-amp built around IC1. One pre-amp is needed for each stereo channel; again, we will only discuss one half of the circuit.

From J1, the input is coupled across R9 and C10 to IC1-b. Those components form a termination load for the phonograph cartridge. The pre-amp is set for a 40-dB gain and is a non-inverting configuration. Two RC networks, C7/R5 and C8/R8, are included in the feedback loop of IC1-b. They reduce the gain of the pre-amp as the frequency increases. The reason that we need to do that has to do with the way that grooves are cut in a record. Higher frequencies are boosted in comparison to low frequencies in a record so that the size of the actual grooves is consistent. The amount of boost is set by the Recording Industry Association of America (RIAA). We are reversing that equalization, restoring a flat-frequency response; hence the use of an RIAA-compensating pre-amp. Additionally, the phonograph pre-amp has a filter network consisting of C6 and R1 that filters out any low-frequency "rumble" from the turntable.

The output of the phonograph pre-amp and the line input are summed into a two-input mixer. The input-mixing stage consists of R11 and R14, both of which are dual potentiometers. The phonograph input level is set by R11; R14 handles the line input. The signals from the potentiometers are combined by a summing amplifier formed by inverting op-amp IC2. The gain of that stage is set by the ratio of the feedback resistors (R15 and R20) and the input resistors (R16-R19). Note that each amplifier receives one channel from each input. The output of the summing amplifiers contains a mixed combination of the phonograph and line-level inputs, of which the level of each can be individually controlled. Additionally, the summing amplifier acts as a buffer amplifier to drive the rest of the circuits, which will be discussed in turn, with no loading effects.

can be substituted, although sometimes it is difficult to actually hear a difference. Examples of some of those devices include the OP-275 from Analog Devices, the LM833 from National Semiconductor, and the OPA2604 and OPA2134 from Burr Brown. Keep in mind that some of those substitutes, like the Burr-Brown devices, can cost as much as \$3.00 each, whereas the NE5532 runs about 60 cents. For those readers with "golden ears", feel free to experiment with alternative devices. Do not use a 741-type of op-amp, such as the LM1458. They simply do not have the ability to function well in high-quality audio circuits.

Input Section. The main-input section shown in Fig. 1 is a good place to start. Note that there are two identical sections, each of which

has a phonograph input and a line-level input for a CD or tape; only

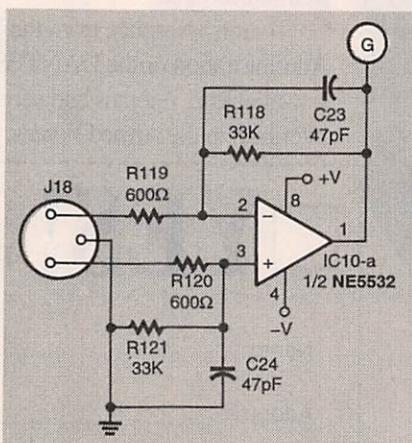


Fig. 2. Any standard low-impedance microphone can be plugged into this preamplifier. The circuit is designed for microphones that have an XLR-type jack. Those microphones use a balanced-line arrangement.

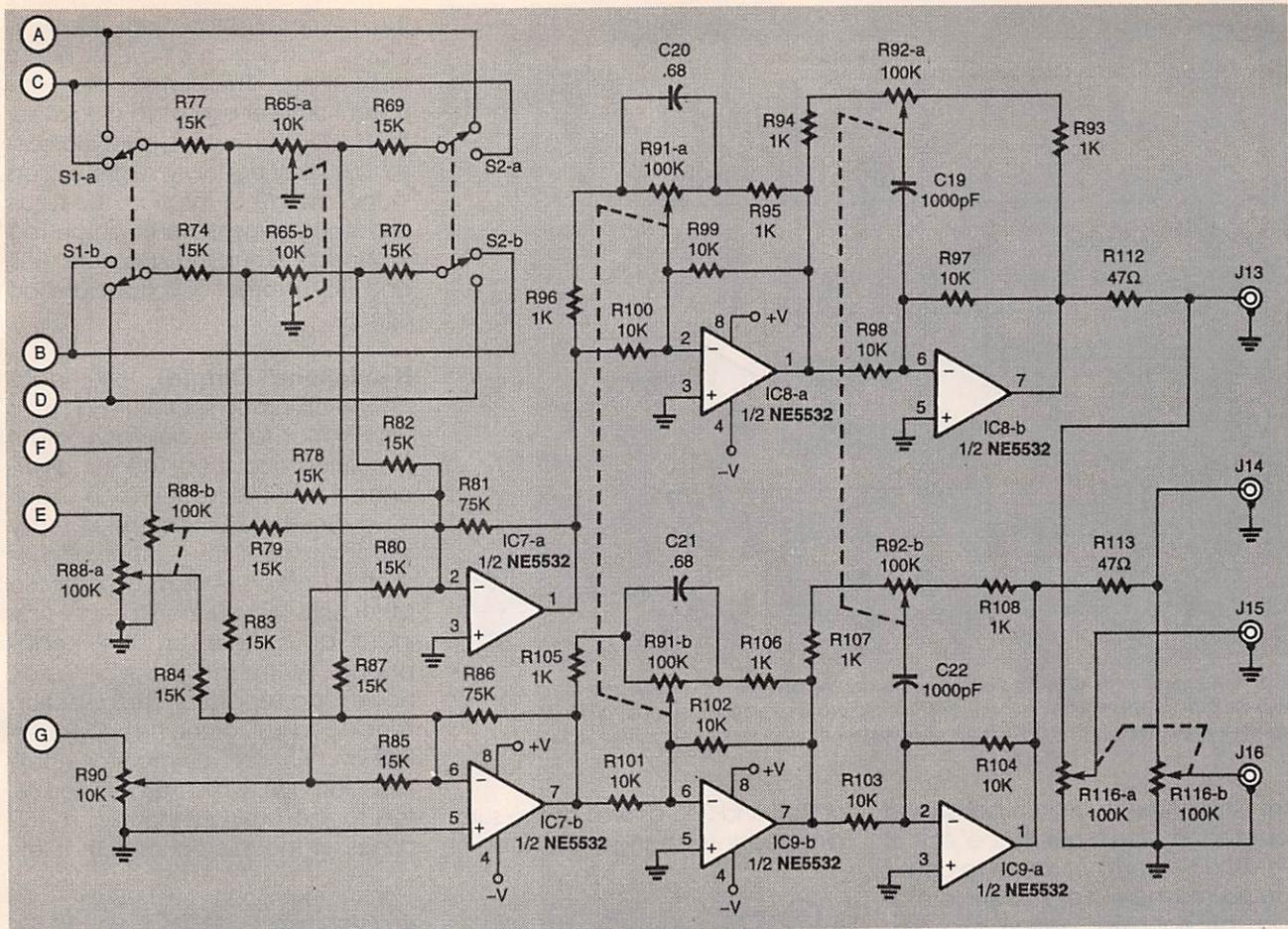


Fig. 3. The "heart and soul" of the DJ MixMaster is the crossfade potentiometer and the transform switches. It is here that the auxiliary input is mixed with the other inputs. The final mixed signal can feed two external amplifiers, or one amplifier and a tape recorder for a "transcript of the proceedings." Bass and treble tone controls are included to help match the sound to the room characteristics and personal preferences.

Microphone Pre-Amp. The microphone pre-amp, shown in Fig. 2, is an op-amp stage that is set up as a differential amplifier around IC10 with a gain of about 35 dB. That amount of gain should be plenty for even the loudest voice. Additional gain is possible as the microphone signal is summed into the other various sections. While such an approach might seem to be a somewhat "cheesy" way to build a microphone pre-amp, the high-quality audio op-amps that are used throughout the DJ MixMaster are up to the task. By using 1% metal-film resistors, noise and circuit complexity are kept to a minimum.

Summing Amp and Output. All of the various inputs are brought together in the summing circuit shown in Fig. 3. The line-level and phonograph inputs are first fed to a

crossfade circuit. That circuit, built around R65, can be thought of as the opposite of a pan or balance control. It allows for a smooth transition from one input to another. Such a circuit is the heart of all DJ-style mixing boards. One of the interesting features incorporated into the DJ MixMaster are "transform" switches S1 and S2. In one set of positions for S1 and S2, R65 is fed with one source input on one side and the other source input on the other side. With that setting, R65 can be used to cross-fade from one input to the other. With the wiper of R65 set to its midrange, each signal is attenuated by about 3 dB. If both signals are identical in amplitude, the output will remain at a constant level as R65 is moved from one end to the other. By throwing one (but not both) of the transform switches, both sides of R65 are fed by the same source sig-

nal. That lets you change instantly between inputs without having to touch the setting of R65. That feature can be useful for special effects and instant changes in the music; no club DJ should be without one! Note that the microphone input (a monophonic signal) is mixed equally into both left and right stereo channels of the summing amplifiers IC7-a and IC7-b; the auxiliary input is mixed in through its own level adjust, R88.

The outputs of IC7 are fed to the EQ section, a standard high/low shelving equalizer very similar to most bass/treble controls. The bass control is built around IC8 and R91, while IC9 and R92 handle the treble. The big difference in the DJ MixMaster circuit is that the boost/cut frequencies are selected to be much more musically useful. The low frequency is centered at about 80 Hz and the high frequency is set

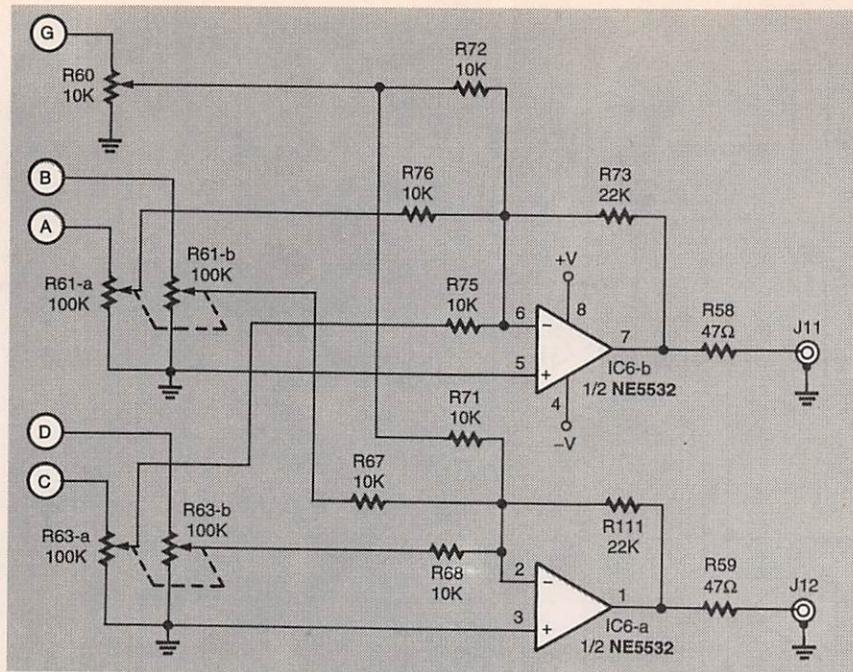


Fig. 4. A separate mix of audio sources—including the microphone—can be sent to the auxiliary output. With an effects processor plugged into the auxiliary outputs, you can add external audio effects and mix them back into the main audio output through the auxiliary input jacks.

for 12 kHz. The available boost and cut range works out to be about ± 14 dB—plenty of range to cause audio mayhem! For more information on equalizer design, two recommended resources are *Audio Application of Operational Amplifiers* by Walt Jung and Don Lancaster's timeless *Active Filter Cookbook*.

The output of the EQ section feeds master level control R116. Output jacks J15 and J16 would be hooked up to an external PA system, while J13 and J14 can be used to record the festivities.

Auxiliary Output. As mentioned before, the DJ MixMaster also has an auxiliary output; the circuit is shown in Fig. 4. The auxiliary output can be used to provide a separate stereo mix for driving another PA system or a tape machine. It can also be used to supply an input to an effects sampler or some other multi-effects processor when the output of such a processor is connected back into the DJ MixMaster through J9 and J10 (see Fig. 1). The two input sections as well as the microphone pre-amp are mixed together with their own potentiometers and summed by IC6.

Note that the choice of values

for R61 and R63 as well as the summing resistors change the "feel" of

the potentiometers from linear to logarithmic, which is how we like to hear things. The further that the potentiometer is rotated clockwise, the faster the output level increases. The most signal increase occurs in the last 1/3 of rotation. The result is a smooth increase in perceived loudness. Coupling resistors R58 and R59 protect IC6 from a short circuit.

Headphone Output. The headphone-amplifier section (Fig. 5) is very similar to the auxiliary output circuit just discussed. The big difference is that the headphone circuit is where the DJ MixMaster really separates itself from other off-the-shelf DJ mixers. Almost all of those other units let you monitor only one input at a time on the headphones. With the DJ MixMaster, however, a separate mixing section is included just for the headphones; R49 and R51 let you monitor inputs one and two, while R53 lets you listen to the auxiliary input and R55 brings up the microphone. That lets

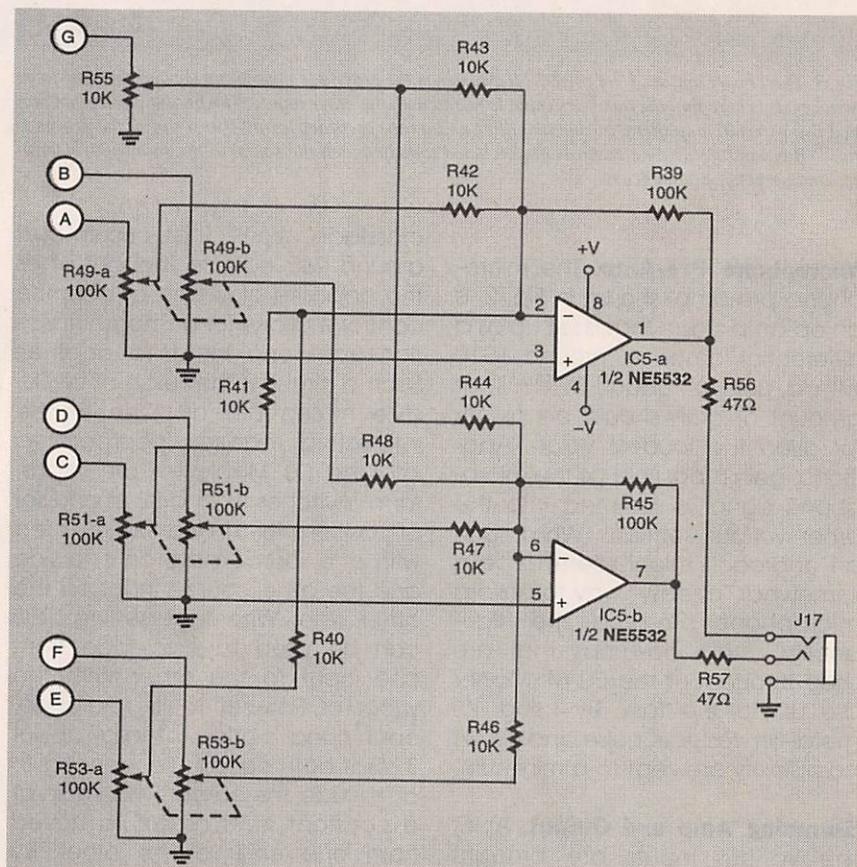


Fig. 5. The headphone amplifier has its own set of mixing controls. With that feature, you can cue up or monitor a different input channel from the one that's playing through the main speakers.

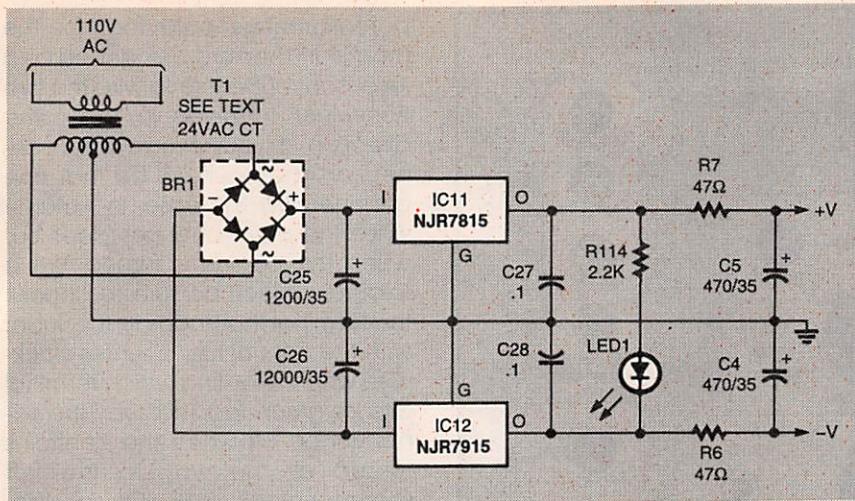


Fig. 6. The DJ MixMaster's power supply uses three-terminal regulators that have an insulated tab; you don't have to worry about using a mica insulator when bolting them to a heatsink.

you match beats, preview an upcoming song, or verify that the microphone is working before sending anything over the PA system.

Like their counterparts in Fig. 4, R56 and R57 protect IC5 from a short circuit; they also provide enough current drive for even 8-ohm headphones.

One final note on the handling of the microphone signal is that only a single-gang potentiometer is used to feed the signal equally to both stereo channels wherever it is sent. Although a stereo-panning potentiometer could have been included, such a function is never really needed in DJ work. For that reason, that feature has been left out of the DJ MixMaster in order to keep the circuit simple.

Power. The power-supply circuit for the DJ MixMaster, shown in Fig. 6, is simple and straightforward. The output of T1, a 24-volt center-tapped transformer, is rectified by BR1 and smoothed by C25 and C26. No fuse is shown because the author's prototype uses a wall-mounted transformer with integral protection. Light-emitting diode LED1 and current-limiting resistor R114 let you know when the unit is turned on.

Note the use of NJR7815 and NJR7915 regulators for IC11 and IC12. While any standard three-terminal regulator can be used, the specified units have the unique feature of an insulated tab. That means that you can mount them straight to a common heatsink

without having to worry about electrically insulating them.

Construction. The DJ MixMaster, in spite of the complexity of the circuit, can easily be built on perfboard using standard construction techniques. One way to lay out the

various circuits for the unit is to build each one on a separate piece of perfboard, one board per schematic figure. All interconnections that carry audio signals should be done with shielded audio cable. Be sure to ground the shield on one end only. If both ends are grounded, the possibility of a "ground loop" exists, the result being stray hum and noise in the audio output.

The case is also a matter of personal choice. The important consideration in that respect is the size of the front panel for all of the controls. The dimensions of the author's prototype case are shown in Fig. 7. The sides and frame are made from poplar wood (for looks) with 1/8-inch sheet aluminum for the front and rear panels. The front panel measures about 10 inches by 16 inches. Sources of sheet aluminum are a local sheet-metal shop or scrap yard. One great source if you live in a small town are used street signs from the local government.

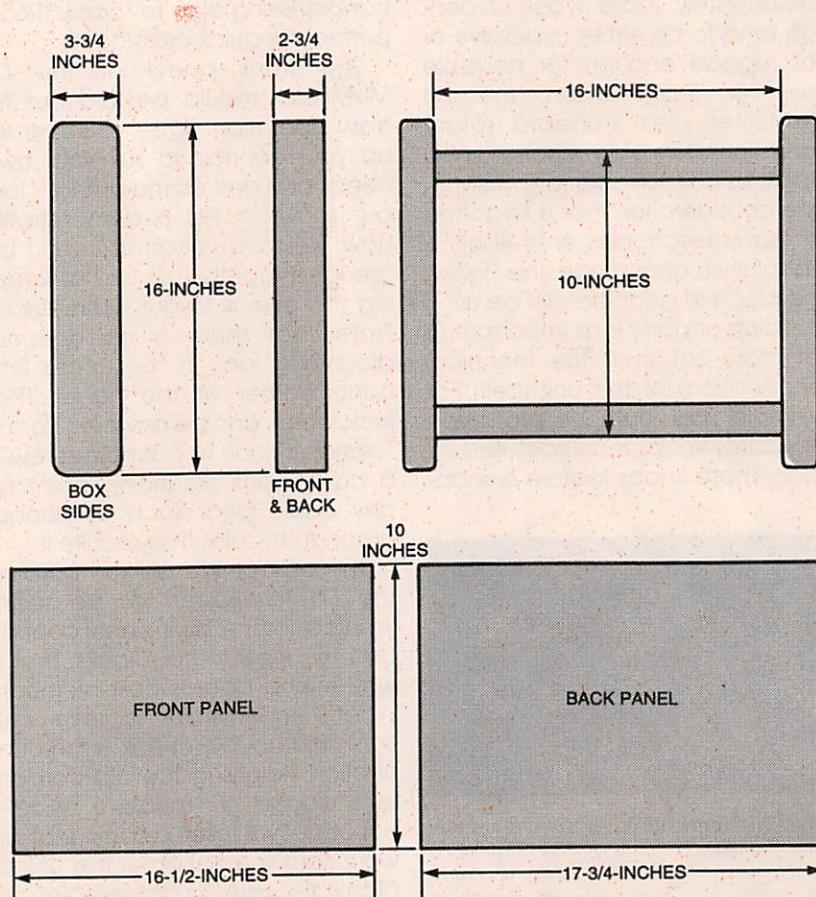


Fig. 7. While any suitable enclosure can be used for the DJ MixMaster, the author's design is large enough to allow an easy-to-use front-panel layout. The unit can even comfortably fit in one's lap.

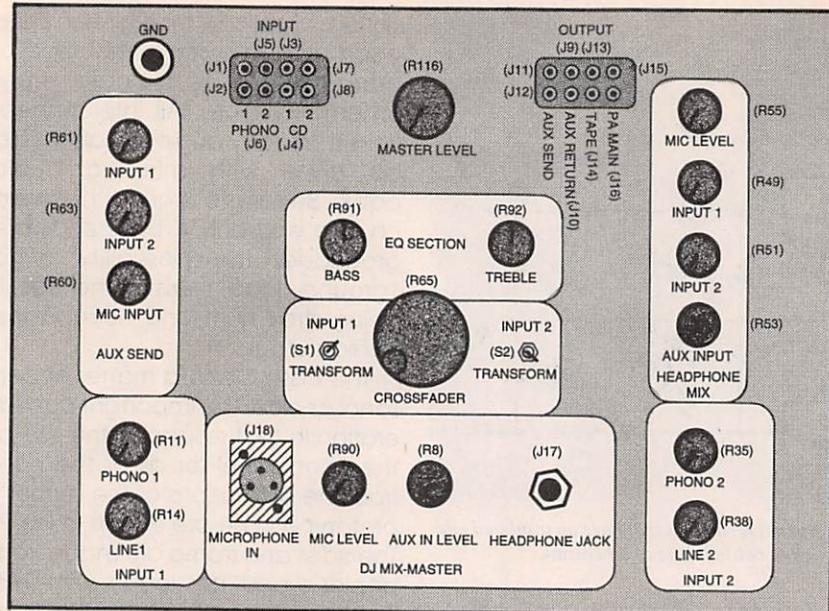


Fig. 8. A clean and orderly layout of controls is essential to any well-designed mixer. Here's how the author organized his prototype DJ Mixer. Feel free to modify this arrangement to your liking.

Along with being the right thickness, street signs are T-6066-grade aluminum. Old dented ones can usually be had for free.

Many mixers use slide pots. Unfortunately, those types of controls tend to be either expensive or not rugged enough for portable use. For that reason, the DJ MixMaster uses standard rotary potentiometers. Any control knob that feels comfortable to you is fine. One consideration that is forgotten by many electronics enthusiasts is that of style and image. The "look" of a piece of gear that will be used at a club or party is as important (if not more so) than the technical specifications of the unit itself! For example, the author's prototype uses collet knobs manufactured by Selco. Those knobs feature a snap-

in face that comes in many colors. Unfortunately, they are more expensive than the potentiometers that they control! For R65, you might consider an extra large knob with a handle. Being able to "crank" R65 is perfect for quick crossfades.

The front panel of the DJ MixMaster should be laid out for easy operation. While you can set up your controls to suit your own needs and desires, the author's layout, shown in Fig. 8, demonstrates how related controls can be grouped together as well as keeping the overall layout symmetrical. Note that there is an optional grounding jack in the upper left-hand corner of the panel. That jack, which can be anything from a "banana" jack to a simple screw, is a convenient grounding point for any audio gear such as phonograph turntables that require it.

The bulk of the work in building the DJ MixMaster will be spent wiring all of the front-panel controls and the input/output jacks. That is why mixing boards cost so much! What's important is to take your time and double check each connection. Applying the old carpenter's adage of "measure twice—cut once" will result in a unit that will work right the first time. The use of plastic tie wraps or cable lacing will aid in a neat and tidy job.

When wiring the dual-gang

potentiometers, note that for the most part they are being used as a level control. Be sure to wire the two non-wiper terminals in the same direction. If you reverse one connection, the result will be that one channel will increase in volume while the other channel fades out when the control is turned. On a related subject, be sure to choose the terminal that shorts to the wiper with the control fully counter-clockwise when selecting which terminal is to be grounded. That way, the signal will be off when the control is turned all the way to the left (counter-clockwise). Of course, there's nothing wrong with wiring the DJ MixMaster so that it works opposite to the traditional arrangement that we are all used to when working with a rotary control. In fact, a DJ Mixmaster that reads "right to left" might be just the thing for those that like to march to the beat of a different drummer!

If you do not want to use a wall-mounted transformer, a standard transformer with a current rating between 300 mA and 1 amp can be used. However, you will have to include additional safety equipment such as a fuse and a power switch. The 110-volt wiring inside the DJ Mixmaster can not only be a problem as a source of hum pickup, it can be very dangerous working around while repairing, modifying, or testing the unit. For those reasons, a wall-mounted transformer cannot be recommended enough from a safety standpoint. On the subject of safety, don't forget to ground any metal panels on the case; a good ground will be needed with some audio gear such as phonograph turntables mentioned before.

Once the DJ MixMaster is built, wired, and checked for any errors, it is ready for testing.

Testing. Because there are so many interrelated sections of the DJ MixMaster, testing must be done in a logical fashion to ensure that everything works properly. Let's start with the headphone section and the auxiliary-return input. Since that combination is a straight-through connection, once we know it works we can check out the other inputs



using the headphone amplifier.

Set all of the controls to their minimum value. Connect a stereo line-level source such as a CD player to J9 and J10. Plug a set of headphones into J17. Start the CD player and turn up R53. You should hear clean, crisp audio with no distortion. Turn down R53 and turn up the other controls. You shouldn't hear any hiss or hum. Connect a microphone to J18 and turn up R55. When you speak into the microphone, you should hear yourself talking along with any other room noise. Go through all of the other inputs (J1-J8) in turn, checking them in the same way. Don't forget to ground any phonograph turntables or the result will be a horrible-sounding test!

Once you have verified that all of the inputs work through the headphone amplifier, connect J15 and J16 to an amplifier and speakers; your stereo will work fine. Repeat all of the different tests, verifying that you can send them to the main mix. Set S1 and S2 in various combinations to see if you can switch between inputs as well as crossfade from one to the other with R65. Any problems that turn up are most likely caused by an error in wiring or a possible solder bridge on one of the perfboards. Remember, even the most careful person can make a seemingly obvious mistake, especially with a circuit as involved as the DJ MixMaster. Once you have checked everything out successfully, it is time to see what cool things the DJ MixMaster can do.

Using the DJ MixMaster. Using the DJ MixMaster is straightforward. Start by setting the input channel levels. Connect your turntables and CD players. Bring up some music on both the phonograph and CD player for the same channel—for example, J1-J4. Set S1 and S2 so that only that input is connected to R65. Adjust R11 and R14 for equal volume levels. Note that those controls should not be fully raised but somewhere in the one- to two-o'clock position. Phonograph signals are a little louder than the line signals, so R11 might be set a little lower. Repeat that procedure for

the other input. Once both input levels are set, they will stay there; your mixing will be done with R65. However, you have the flexibility to do additional submixing. One interesting trick is to leave a turntable running with the needle at the end of a record. All that you will hear is the repetitive scratching sound of the record. Mix that in with music from CDs as an effect. That is easy to do with the DJ MixMaster because you can have two CD players and a turntable connected at the same time. Most other mixers force you to switch between the phonograph and line-level inputs.

Transform switches S1 and S2 take a little getting used to. They let you instantly switch between input channels. With a little practice, you'll be the hit of the dance floor. You can do things like create an "extended mix" of a song by having two copies of the song playing. At the end of one chorus or break, cue up the second copy at an earlier portion and hit the transform buttons. That is also how DJs bring in scratching from a turntable or other sound effects.

The auxiliary input and output circuits let you do all sorts of audio mayhem. For example, digital multi-effects processors for use in studios are available for less than \$200. Almost any effect that you have heard on a song or the radio such as reverb, delays, flanging, chorusing, and pitch transposition are all available. Some will even "sample" the input applied to them; they will digitally record the audio fed to them for about five seconds and store it, ready to be played back at the push of a button. When used with the DJ MixMaster, you can process your voice when making announcements, process the music you are playing, and sample either your or someone else's voice. In a club, you will be right up with the best DJs. For example, you could use a pitch-transposing device to drop your voice down by a fifth and say something like, "You! In the red dress! You are evil and no one on this planet likes you!" At functions like weddings where some one is making a toast, sliding a little delay on their voice unexpectedly can result in all sorts of fun. Don't go

overboard with an effect like that, but it is the perfect thing for a slightly-tipsy relative who is trying to make the "speech of the decade". The possibilities are endless. If you won't be using effects processors, the auxiliary input can be used as an additional CD player or tape deck.

The DJ Mix Master is a formidable audio tool. It is compact, yet has features not found on even top-of-the-line mixing boards. You can easily build it in a couple of evenings and then launch yourself into a new career as a Disc Jockey or at least have a lot of fun at parties! Ω

ELECTRONIC GAMES

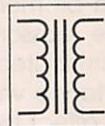
BP69—A number of interesting electronic game projects using IC's are presented. Includes 19 different projects ranging from a simple coin flipper, to a competitive reaction game, to electronic roulette, a combination lock game, a game timer and more. To order BP69 send \$4.99 clearance (includes s&h) in the US and Canada to Electronic



Technology Today Inc., P.O. Box 240, Massapequa Park, NY 11762-0240. US funds only. Use US bank check or International Money Order. Allow 6-8 weeks for delivery.

MA07

Coil Design and Construction Manual



YOU CAN WIND YOUR OWN COILS?

There's no trick to it except knowing what you are doing. In a unique, 106-page book you can become expert in winding RF, IF, audio and power coils, chokes and transformers. Practically every type of coil is discussed and necessary calculations are given with the mathematical data simplified for use by anyone. Get your copy today!

Mail coupon to:

**Electronics Technology Today, Inc.
P.O. Box 240
Massapequa Park, NY 11762-0240**

Please send me my copy of *Coil Design and Construction Manual* (BP160). I enclose a check or money order for \$8.99 to cover the book's cost and shipping-and-handling expenses. NY state residents must add local sales tax.

Name _____

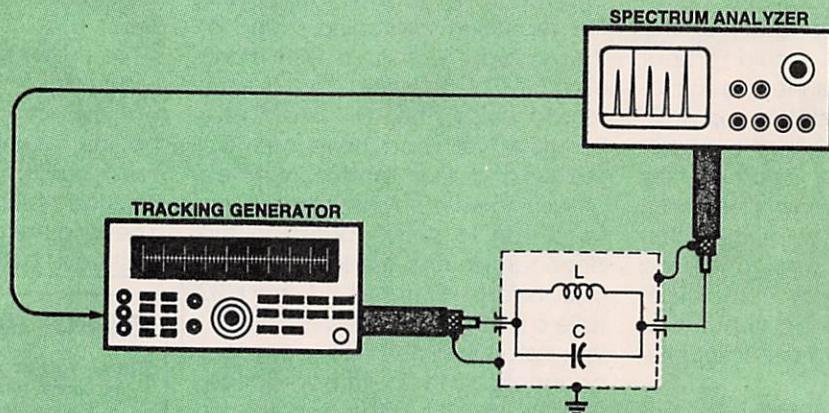
Address _____

City _____ State _____ ZIP _____

All orders must be paid in U.S. funds only. Sorry, no orders accepted outside of USA and Canada. Please allow 6-8 weeks for delivery.

ET07

Measuring Inductors and Capacitors at RF Frequencies



At low frequencies, measuring inductance and/or capacitance is no big deal, but get to RF frequencies and things get a lot more interesting.

The techniques needed to measure the values of inductors (L) and capacitors (C) at radio frequencies differs somewhat from what is needed to make the same measurements at low frequencies. In short, although similarities exist, the RF measurement is a bit more complicated. One of the reasons for that is that stray or "distributed" inductance and capacitance values of the test set-up will affect the results. Another reason is that capacitors and inductors are not ideal components, but rather all capacitors have some inductance, and all inductors have capacitance. In this article we will take a look at several effective methods for measuring inductance and capacitance at RF frequencies.

VSWR Method. When a load impedance is connected across an RF source, the maximum power transfer occurs when the load (Z_L) and source (Z_S) impedances are equal ($Z_L = Z_S$). If those impedances are not equal, then the *voltage standing wave ratio* (VSWR) will indicate the degree of mismatch. We can use that phenomenon to measure values of inductance and

shown in Fig. 1A. The instrumentation required includes a signal generator or other signal source, and a VSWR meter or VSWR analyzer.

Some VSWR instruments require a transmitter for excitation, but others will accept the lower signal levels that can be produced by a signal generator. An alternative device is an SWR-analyzer type of instrument. It contains the signal generator and VSWR meter, along with a frequency counter to be sure of the actual test frequency. Whatever signal source is used, however, it must have a variable output frequency. Further, the frequency readout must be accurate (the accuracy of the method depends on knowing the actual frequency).

The load impedance inside the shielded enclosure consists of a non-inductive resistor (R) that has a resistance equal to the desired system impedance resistive component (50 ohms in most RF applications, and 75 ohms in television and video). An inductive reactance (X_L) and a capacitive reactance (X_C) are connected in series with the load. The circuit containing a resistor, capacitor, and inductor simu-

lates an antenna-feedpoint impedance. The overall impedance is:

$$Z_L = \sqrt{R^2 + (X_L - X_C)^2} \quad (1)$$

Note the reactive portion of Equation 1. When the condition $|X_L| = |X_C|$ exists, the series network is at resonance, and VSWR is minimum (see Fig. 1B). This gives us a means for measuring the values of the capacitor or inductor, provided that the other is known. That is, if you want to measure a capacitance, then use an inductor of known value. Alternatively, if you want to know the value of an unknown inductor, use a capacitor of known value.

Using the test set-up in Fig. 1A, adjust the frequency of the signal source to produce minimum VSWR.

1. For finding an inductance from a known capacitance:

$$L_{\mu H} = \frac{10^{12}}{4\pi^2 f^2 C_{PF}} \quad (2)$$

Where:

$L_{\mu H}$ = inductance in microhenrys (μH)
 C_{PF} is the capacitance in picofarads (pF)

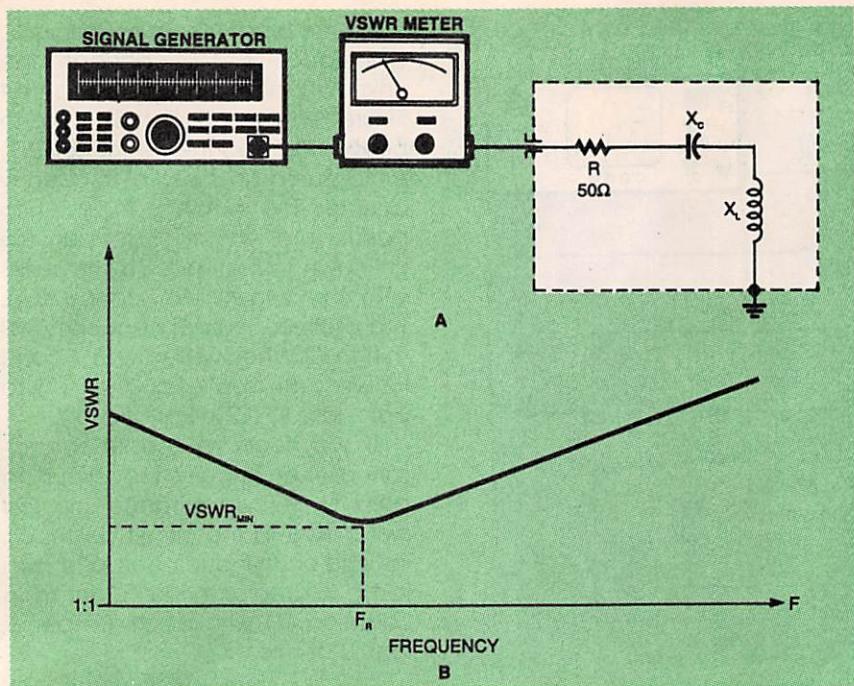


Fig. 1. The VSWR method for measuring L and C is shown in A while the VSWR-vs.-frequency curve is shown in B.

f is the frequency in hertz (Hz)

2. For finding a capacitance from a known inductance:

$$C_{pF} = \frac{10^{12}}{4\pi^2 f^2 L_{\mu H}} \quad (3)$$

The accuracy of this approach depends on how accurately the frequency and the reactance are known, and how accurately the minimum VSWR frequency can be found.

Voltage Divider Method. A resistive voltage divider is shown in Fig. 2A. This circuit consists of two resistors (R_1 and R_2) in series across a voltage source V . The voltage drops across R_1 and R_2 are V_1 and V_2 , respectively. We know that either voltage drop is found from:

$$V_X = \frac{VR_X}{R_1 + R_2} \quad (4)$$

Where: V_X is V_1 and R_X is R_1 or, V_X is V_2 and R_X is R_2 , depending on which voltage drop is being measured.

We can use the voltage divider concept to find either inductance or capacitance by replacing R_2 with the unknown reactance.

Consider first the inductive case. In Fig. 2B resistor R_2 has been replaced by an inductor (L). Resistor R_1 is the inductor series resistance. If we measure the voltage drop across R_1 (i.e. "E" in Fig. 2B), then we can calculate the inductance from:

$$L = \frac{R}{2\pi f} \times \sqrt{\left(\frac{V}{E}\right)^2 - \left(1 + \frac{R_S}{R_1}\right)^2} \quad (5)$$

As can be noted in Equation 5, if $R_1 \gg R_S$, then the quotient R_S/R_1 becomes negligible.

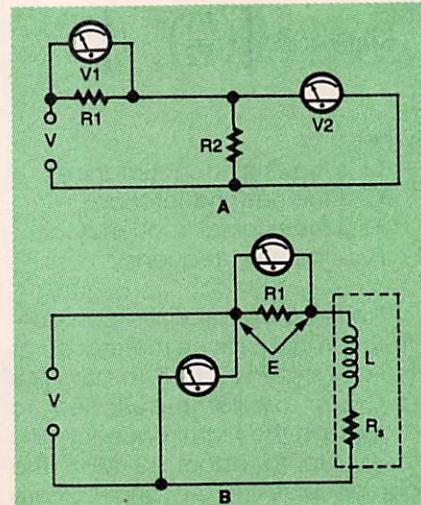


Fig. 2. A simple voltage divider is shown in A and a reactance voltage divider is in B.

In capacitors the series resistance is typically too small to be of consequence. We can replace L in the model of Fig. 2B with a capacitor, and again measure voltage E . The value of the capacitor will be:

$$C = \frac{2\pi f \times 10^6}{R \times \sqrt{\left(\frac{V}{E}\right)^2 - 1}} \quad (6)$$

The value of resistance selected for R_1 should be approximately the same order of magnitude as the expected reactance of the capacitor or inductor being measured. For example, if you expect the reactance to be, say, between 1000- and 10,000-ohms at some frequency, then select a resistance for R_1 in this same range. That will keep the voltage values manageable.

Signal Generator Method. If the frequency of a signal generator is accurately known, then we can use a known inductance to find an unknown capacitance, or a known capacitance to find an unknown inductance. Figure 3 shows the test set-up for this option. The known and unknown components (L and C) are connected together inside a shielded enclosure. The parallel-tuned circuit is lightly coupled to the signal source and the display through very low-value capacitors (C_1 and C_2). The rule is that the reactance of C_1 and C_2 should be very high compared with the reactances of L and C at resonance.

The signal generator is equipped with a 6-dB resistive attenuator in order to keep its output impedance stable. The output indicators should be any instrument that will read the RF voltage at the frequency of resonance. For example, you could use either an RF voltmeter or an oscilloscope.

The procedure requires tuning the frequency of the signal source to provide a peak output-voltage reading on the voltmeter or scope. If the value of one of the components (L or C) is known, then the value of the other can be calculated using Equation 2 or 3, as appropriate.

Alternate forms of coupling are

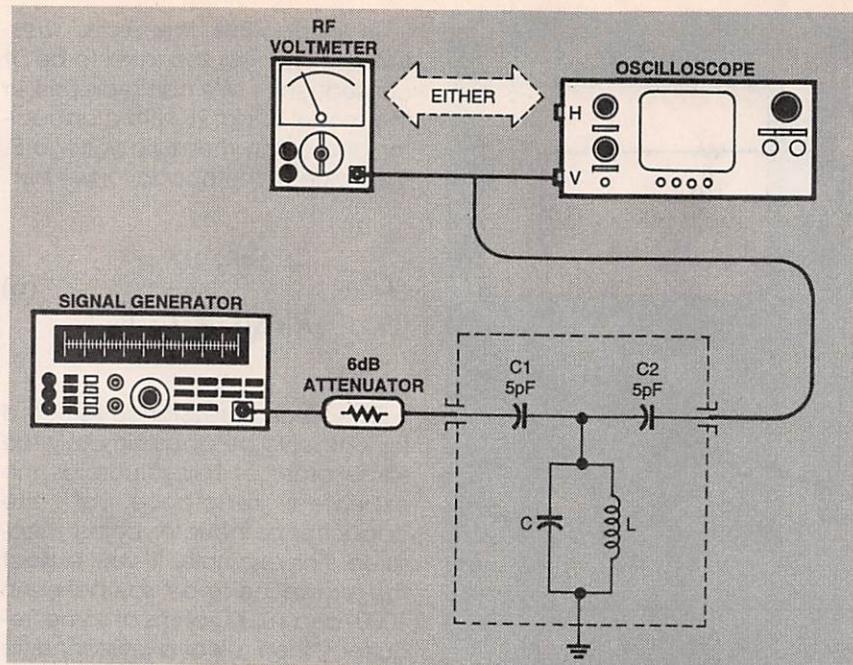


Fig. 3. If the frequency output of a signal generator is accurately known, we can use a known inductance to find an unknown capacitance, or vice versa.

shown in Fig. 4. In either case, the idea is to isolate the instruments from the L and C elements. In Fig. 4A the isolation is provided by a pair of high-value (10,000-ohm to 1 megohm) resistors, R1 and R2. In Fig. 4B the coupling and isolation is pro-

vided by a one- or two-turn link winding over the inductor. The links and the main inductor are lightly coupled to each other.

Frequency-Shifted Oscillator Method.

The frequency of a variable-frequency oscillator (VFO) is set by the combined action of an inductor and a capacitor. We know that a change in either capacitance or inductance produces a frequency change equal to the square of the component ratio. For example, for an inductance change:

$$L_2 = L_1 \times \left[\left(\frac{F_1}{F_2} \right)^2 - 1 \right] \quad (7)$$

Where:

- L1 is the original inductance
- L2 is the new inductance
- F1 is the original frequency
- F2 is the new frequency

From this equation we can construct an inductance meter such as the one shown in Fig. 5. This circuit is a Clapp oscillator designed to oscillate in the high-frequency (HF) range up to about 12 MHz. The components L1, C1, and C2 are selected to resonate at some frequency. Inductor L1 should be of

the same order of magnitude as L_X. The idea is to connect the unknown inductor across the test fixture terminals. Switch S1 is set to position "b" and the frequency (F1) is measured on a digital frequency counter. The switch is then set to position "a" in order to put the unknown inductance (L_X) in series with the known inductance (L1). The oscillator output frequency will shift to F2. When we know L1, F1 and F2 we can apply Equation (7) to calculate L_X (L2 in Equation 7).

If we need to find a capacitance, then modify the circuit to permit a capacitance to be switched into the circuit across C1 instead of an inductance as shown in Fig. 5. Replace the "L" terms in Equation (7) with the corresponding "C" terms.

Using RF Bridges. Most RF bridges are based on the DC Wheatstone bridge circuit (see Fig. 6). In use since 1843, the Wheatstone bridge has formed the basis for many different measurement instruments. The *null condition* of the Wheatstone bridge exists when the voltage drop of R1/R2 is equal to the voltage drop of R3/R4. When the condition $R_1/R_2 = R_3/R_4$ is true, then the voltmeter (M1) will read zero. The basic measurement scheme is to know the values of three of the resistors, and use them to measure the value of the fourth. For example, one common scheme is to connect the unknown resistor in place of R4, make R1 and R3 fixed resistors of known value, and R2 is a calibrated potentiometer marked in ohms. By adjusting R2 for the null condition, and then reading its value, we can use the ratio $(R_2 \times R_3)/R_1 = R_4$.

The Wheatstone bridge works well for finding unknown resistances from DC to some relatively low RF frequencies, but to measure L and C values at higher frequencies we need to modify the bridge. Three basic versions are used: Maxwell bridge (Fig. 7), Hay bridge (Fig. 8), and Schering bridge (Fig. 9).

Maxwell Bridge. The Maxwell bridge is shown in Fig. 7. The null condition for this bridge occurs when:

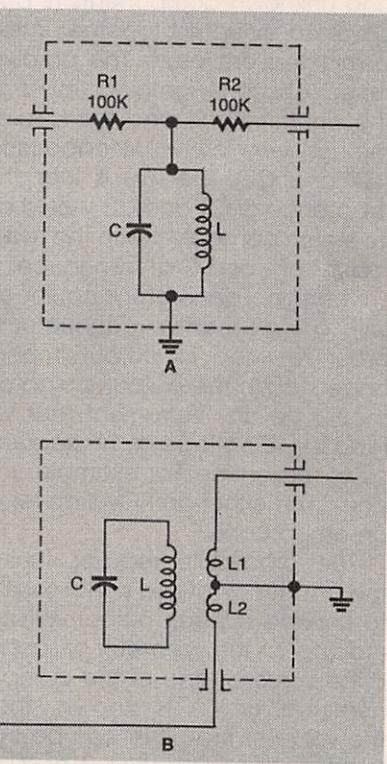


Fig. 4. Different ways to couple L and C elements to the test instruments.

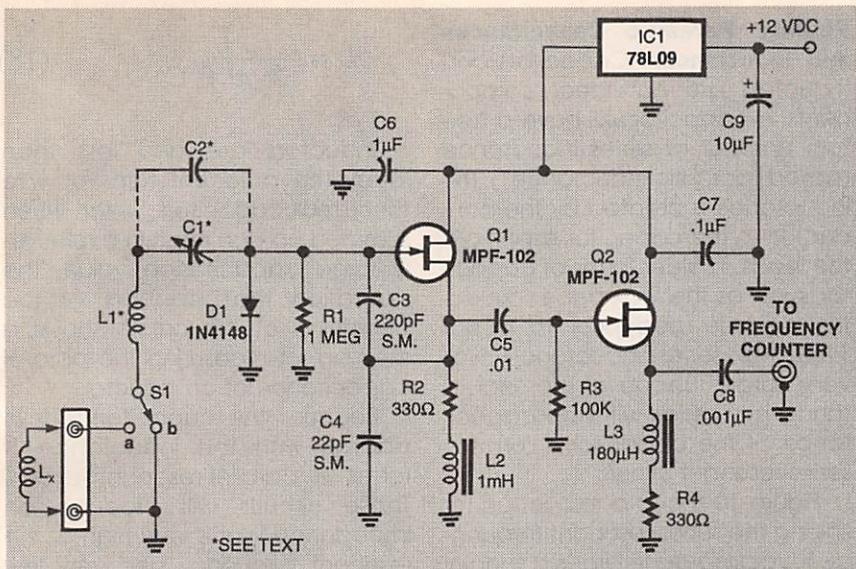


Fig. 5. This circuit uses the frequency-shift method to measure the value of an unknown inductance. It is easily modified to measure an unknown capacitor instead.

$$L1 = R2 \times R3 \times C1 \quad (8)$$

uses of this bridge is inductance measurements.

Maxwell bridge circuits are often

and

$$R4 = \frac{R2 \times R3}{R1} \quad (9)$$

The Maxwell bridge is often used to measure unknown values of inductance (e.g. L1) because the balance equations are totally independent of frequency. The bridge is also not too sensitive to resistive losses in the inductor (a failing of some other methods). Additionally, it is much easier to obtain calibrated standard capacitors for C1 than it is to obtain standard inductors for L1. As a result, one of the principal

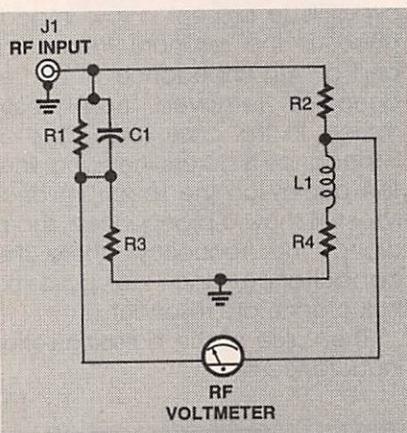


Fig. 7. In the Maxwell bridge, the balance equations are independent of the frequency.

used in measurement instruments called *Q-meters*, which measure the quality factor (Q) of inductors. The equation for Q is, however, frequency sensitive:

$$Q = 2 \times \pi \times F \times R1 \times C1 \quad (10)$$

Where: F is in Hertz, R1 in ohms, and C1 in farads.

Hay Bridge. The Hay bridge (see Fig. 8) is physically similar to the Maxwell bridge, except that the R1/C1 combination is connected in series rather than parallel. Unlike the Maxwell bridge, the Hay bridge is

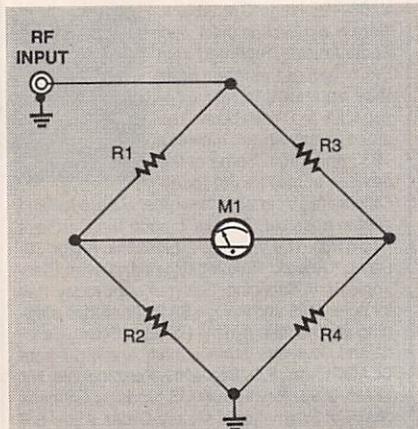


Fig. 6. The Wheatstone bridge has been used since 1843.

frequency sensitive. The balance equations for the null condition are also a little more complex:

$$L1 = \frac{R2 \times R3 \times C1}{1 + \left[\frac{1}{Q} \right]^2} \quad (11)$$

$$R4 = \left[\frac{R2 \times R3}{R1} \right] \times \left[\frac{1}{Q^2 + 1} \right] \quad (12)$$

Where:

$$Q = \frac{1}{\omega \times R1 \times C1} \quad (13)$$

The Hay bridge is used for measuring inductances with high Q figures, while the Maxwell bridge is best with inductors that have a low Q value.

Note: A frequency-independent version of Equation (11) is possible when Q is very large (i.e. >100):

$$L1 = R2 \times R3 \times C1 \quad (14)$$

Schering Bridge. The Schering bridge circuit is shown in Fig. 9. The balance equations for the null condition are:

$$C3 = \frac{C2 \times R1}{R2} \quad (15)$$

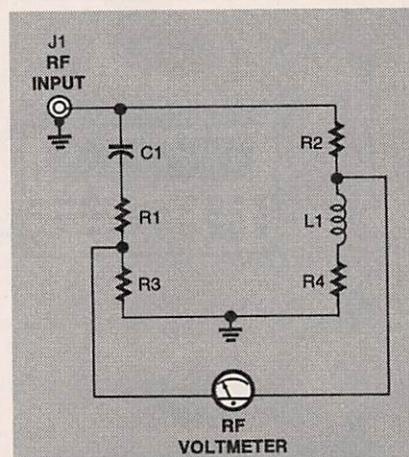


Fig. 8. The Hay bridge is used to measure inductances with high Q values.

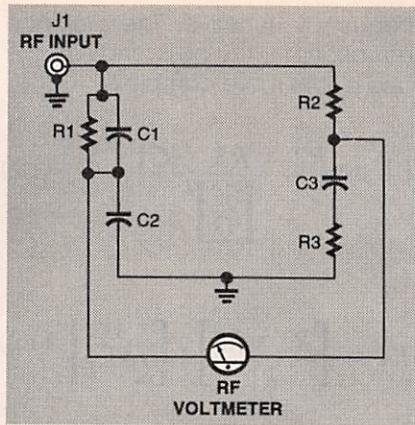


Fig. 9. The Schering bridge is used to find the capacitance and power factor of capacitors.

and

$$R3 = \frac{C2 \times R1}{R2} \quad (16)$$

The Schering bridge is used primarily for finding the capacitance and the power factor of capacitors. In the latter applications no actual $R3$ is connected into the circuit, making the series resistance of the capacitor being tested (e.g. $C3$) the only resistance in that arm of the bridge. The capacitor's Q factor is found from:

$$Q_{C3} = \frac{1}{\omega \times R1 \times C1} \quad (17)$$

Finding Parasitic Capacitances and Inductances.

Capacitors and inductors are not ideal components. A capacitor will have a certain amount of series inductance (called "parasitic inductance"). This inductance is created by the conductors in the capacitor, especially the leads. In older forms of capacitor, such as the wax-paper dielectric devices used prior to about 1960, the series inductance was very large. Because the inductance is in series with the capacitance of the capacitor, it forms a series-resonant circuit.

Figure 10 shows a test set-up for finding the series-resonant frequency. A tracking generator is a special form of sweep generator that is synchronized to the frequency sweep of a spectrum analyzer. They are used with spectrum analyzers in order to perform stimulus-response measurements such as Fig. 10.

The nature of a series-resonant circuit is to present a low impedance at the resonant frequency, and a high impedance at all frequencies removed from resonance. In this case (Fig. 10), that impedance is across the signal line. The display on the spectrum analyzer will show a pronounced, sharp dip at the frequency where the capacitance and the parasitic inductance are resonant.

The value of the parasitic series inductance is:

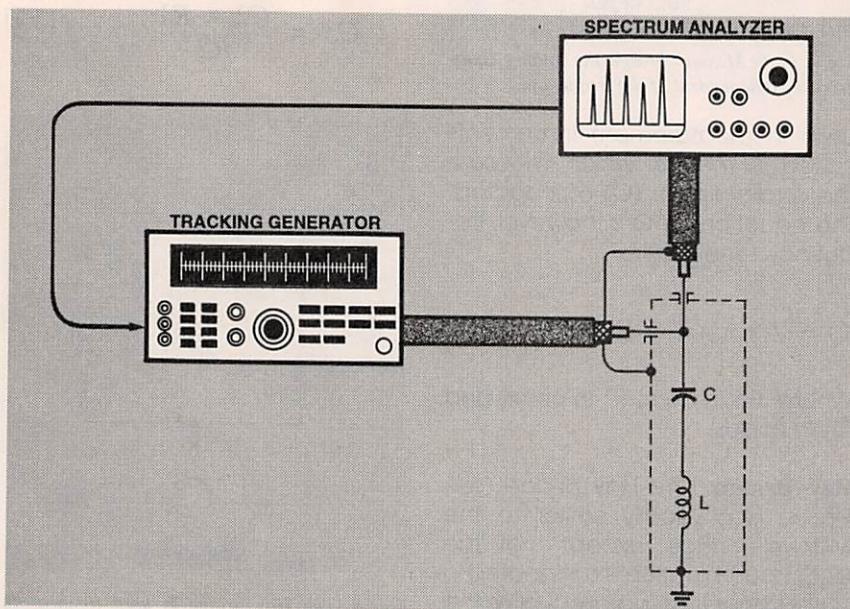
$$L = \frac{1}{2^2 \pi^2 f^2 C} \quad (18)$$

Inductors are also less than ideal. The adjacent turns of wire form small capacitors, which when summed up can result in a relatively large capacitance value. The illustration that appears at the beginning of this article shows a method for measuring the parallel capacitance of an inductor.

Because the capacitance is in parallel with the inductance, it forms a parallel-resonant circuit. Those circuits will produce an impedance that is very high at the resonant frequency, and very low at frequencies removed from resonance. In the lead illustration, the inductor and its parasitic parallel capacitance are in series with the signal line, so will (like the other circuit) produce a pronounced dip in the signal at the resonant frequency. The value of the parasitic inductance is:

$$C = \frac{1}{2^2 \pi^2 f^2 L} \quad (19)$$

Conclusion. There are other forms of bridges, and other methods, for measuring L and C elements in RF circuits, but those discussed here are the most practical. That's especially true if you do not own or have access to specialized instruments. Ω



THE COLLECTED WORKS OF MOHAMMED ULLYSES FIPS

#166—By Hugo Gernsback. Here is a collection of 21 April Fools Articles, reprinted from the pages of the magazines they appeared in, as a 74-page, 8½ x 11-inch book. The stories were written between 1933 and 1964. Some of the devices actually exist today. Others are just around the corner. All are fun and almost possible. Stories include the Cordless Radio Iron, The Visi-Talkie, Electronic Razor, 30-Day LP Record, Teleyeglasses and even Electronic Brain Servicing. Get your copy today. Ask for book #166 and include \$9.99 (includes shipping and handling) in the US (First Class), Canada and Overseas (surface mail), and order from CLAGGK Inc., P.O. Box 4099, Farmingdale, NY 11735-0793. Payment in US funds by US bank check or International Money Order. Allow 6-8 weeks for delivery. MA05

"Sniff" Out Transmitters with the RF Informant

Do more than search for transmitters with this pocket-sized RF-strength meter.

RICK DUKER

Mention the phrase "transmitter detector" and the first image that comes to mind is probably one of searching for hidden surveillance microphones, or "bugs". However, there is a use for such "bug sniffers" beyond the scope of the standard "James Bond" scenario. Examples of using an RF detector on the test bench include checking the operation of devices such as two-way transceivers, ham radios, cellular and cordless telephones, and baby-room monitors. Yet another some-

what unique and interesting application for this device is checking microwave ovens for leakage.

The pocket-sized RF Informant presented here is just such a device. Technically, it can be described as an AM/FM near-field radio-frequency receiver. The relative field strength of any RF signal that is in close proximity to the RF Informant's antenna is monitored, with the field strength displayed on a row of nine LEDs. An audio output is provided for earphone monitoring of the received signals.

The RF Informant operates in two reception modes — *wideband* and *highband*. In the *wideband* mode, the receiver is un-tuned and will detect practically any RF frequency from the low AM band below 500 kHz into the microwave range above 2 GHz. In the *highband* mode, the receiver is optimized for operation in the FM broadcast band.

And yes, the RF Informant can locate hidden transmitter surveillance "bugs".

Circuit Description. The schematic diagram for the RF Informant is shown in Fig. 1. RF signals arriving at ANT1 are coupled by C5 to the detection circuit. A high-impedance ground connection for wideband reception is provided by R3. With S1 switched into the circuit by S2, the circuit is optimized for the FM band.

Diodes D1 and D2 do detection and demodulation. The detected signal is fed to the non-inverting input of IC1. That op-amp is configured as a non-inverting amplifier with a fixed gain of about 450. The particular device specified uses junction field-effect transistors (JFETs) on the inputs; that increases sensitivity due to their high impedance. Potentiometer R9 is a squelch control that adjusts the offset of IC1. The amplified detector output that appears on pin 6 of IC1 is fed to J1. A suitable high-impedance ear-

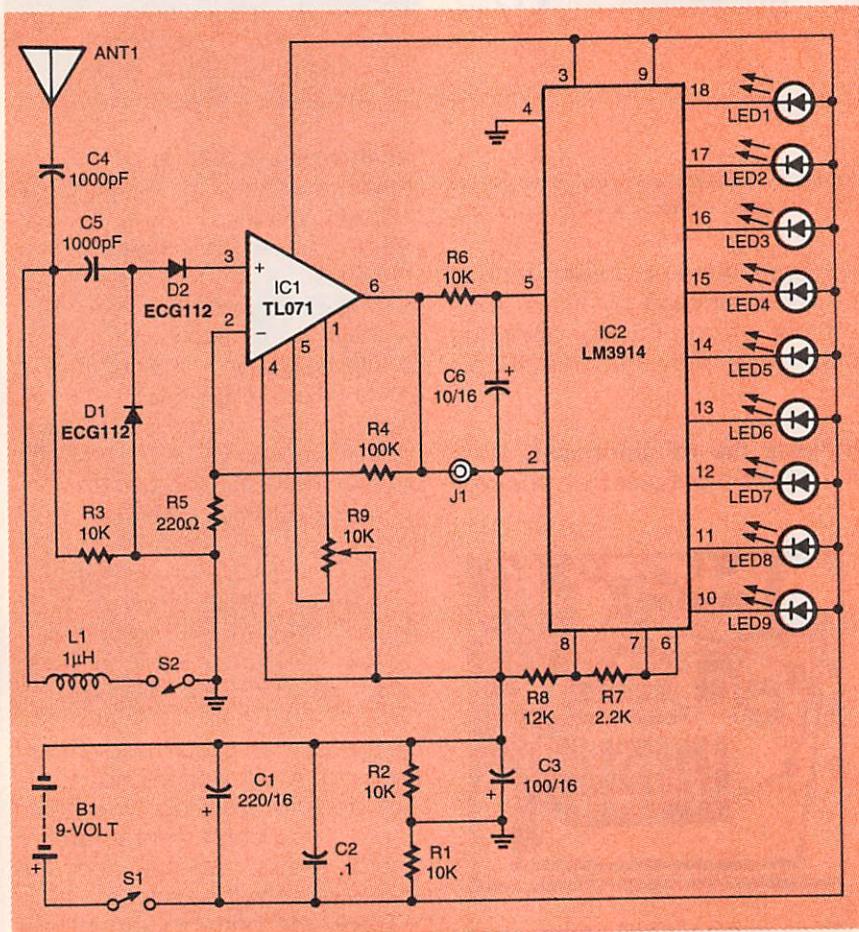


Fig. 1. The RF Informant is a wideband receiver that can show the relative strength of the received signal on a series of LEDs. An earphone can also be used to listen to the received signal. Closing S2 can enhance sensitivity in the FM band.

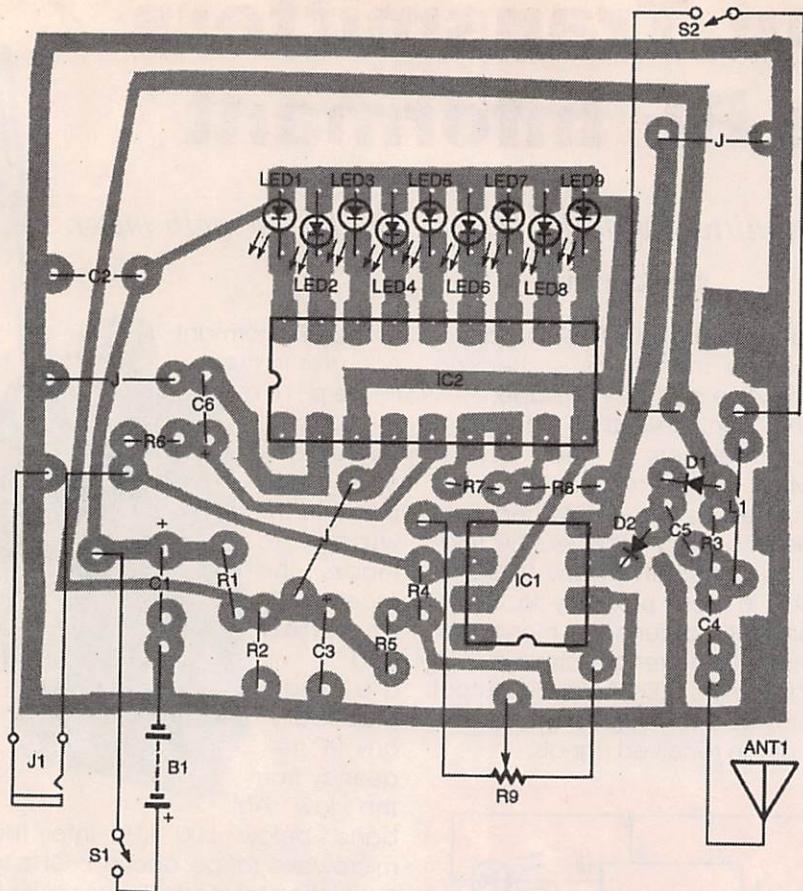


Fig. 2. The RF Informant must be built on a PC board; use this parts-placement diagram if you are using the foil pattern provided in this article. Don't forget to install the jumpers where indicated.

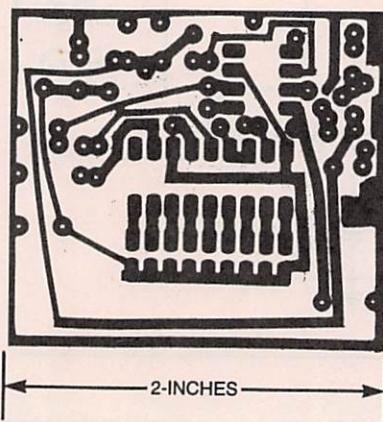
phone can be connected to J1 if you need to listen to the detected signal. Additionally, R6 and C6 smooth the signal.

The smoothed signal is then applied to the input of IC2, an LM3914 dot/bar display. That chip contains a resistor network and a set of comparators. Depending on the input voltage applied to pin 5, one or more LEDs will be turned on to display the relative voltage level. In the RF Informant, a bar display is selected by tying pin 3 to the positive supply voltage; at the lowest voltage, only LED9 will be illuminated. As the voltage increases, each LED comes on in turn until, at the highest voltage level, all nine devices are glowing. Resistors R7 and R8 set the reference voltage for a full-scale reading. Note that there are no current-limiting resistors for the LEDs; R7 and R8 limit the LED current as well.

Since IC1 requires a split power supply, R1, R2, and C3 create a

"ground" reference. Even though power is supplied by B1, a 9-volt battery, C1 and C2 filter any noise that might stray into the supply lines.

Building the RF Informant. Since the RF Informant uses high frequen-



Here's the foil pattern for the RF Informant. Using a single-sided board makes the board easy to etch and the project easy to build.

PARTS LIST FOR THE RF INFORMANT

SEMICONDUCTORS

IC1—TL071 operational amplifier, integrated circuit
 IC2—LM3914 Dot/bar display driver, integrated circuit
 DI, D2—ECG112 or similar silicon diode
 LED1-LED9—Light-emitting diode, red subminiature

RESISTORS

(All resistors are 1/4-watt, 5% units unless otherwise noted.)
 R1-R3, R6—10,000-ohm
 R4—100,000-ohm
 R5—220-ohm
 R7—2200-ohm
 R8—12,000-ohm
 R9—10,000-ohm potentiometer, panel mount (see text)

CAPACITORS

C1—220- μ F, 16-WVDC, electrolytic
 C2—0.1- μ F, ceramic-disc
 C3—100- μ F, 16-WVDC, electrolytic
 C4, C5—1000-pF, ceramic-disc
 C6—10- μ F, 16-WVDC, electrolytic

ADDITIONAL PARTS AND MATERIALS

L1—1- μ H inductor
 S1—Single-pole, single-throw switch (see text)
 S2—Single-pole, single-throw switch
 J1—Subminiature phone jack
 B1—9-volt battery
 ANT1—Telescoping antenna

Note: The following items are available from Quantum Research, 17919 77th Ave., Edmonton, AB, CA T5T 2S1: Etched and drilled PC board, \$10.00; Kit of all parts, enclosure, and PC board, \$69.95; Assembled RF Informant, \$99.95. Please add \$5.00 for shipping. All prices are in US dollars. Canadian residents must add appropriate PST and GST.

cles, a printed-circuit board must be used. A foil pattern has been included for making your own board. If you don't want to etch a board, one is available from the source given in the Parts List.

Follow the parts-placement diagram shown in Fig. 2 for the locations of the various components. While there is no necessary order when installing the parts, it is best to always

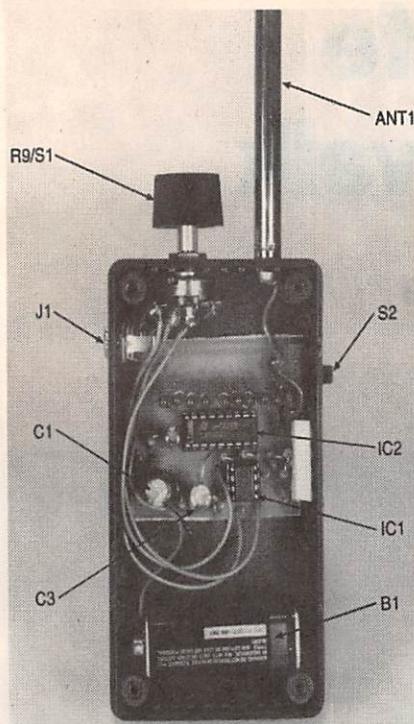


Fig. 3. The completed RF Informant fits in a case that's comfortable to hold. Note that in the author's prototype shown here, R9 and S1 are combined into a single unit. That way, a single control can be used for both switching the RF Informant on and off as well as adjusting the gain of IC1—a method used on almost all radios.

start with the smallest ones first; heat- and static-sensitive devices, such as semiconductors, should be saved for last. In light of that, start with the jumper wires. You can clip a short piece of lead from a resistor for use as a jumper. If you want to use sockets for the ICs, they should be mounted at this time, also.

The capacitors, resistors, and L1 are all mounted vertically. Note that C1, C3, and C6 are polarized components; double-check their orientation before installing them.

We are now ready for the semiconductors. Watch the orientation with those; be sure that they are facing the correct way before soldering them to the board. After mounting D1 and D2, install LED1-LED9. The light-emitting diodes must be mounted high enough off of the board so that they can be seen through the case cover. Most diodes have leads that will let you mount them so that the tips of the components are about 1 inch above the board. Keep them as long as possible.

Prepare the enclosure by drilling

holes for S1, S2, R9, J1, and ANT1. An example arrangement is shown in Fig. 3. Note that in that example (the author's prototype), R9 and S1 are one physical component. Using a switched potentiometer like that gives the RF Informant the operational feel of a standard radio. Install those components in the enclosure. If you absolutely can't locate a switched potentiometer, separate components could be used.

A window is needed on the cover for the LEDs. An easy way to "mill" a slot is to mark the location for the "window" and drill a row of holes across the cover. Once the holes are drilled, file the rough edges so that a slot is created. With the PC board temporarily placed in the case and the cover on, the LEDs should be visible through the slot.

Insulated wires are used to connect the rest of the components to the board. When everything is connected, the board is fixed in place with double-sided foam tape or a couple of dabs of silicone adhesive.

Finally, install the ICs in their sockets, making sure that they are plugged in the right way around. Snap a fresh 9-volt battery in place, and the RF Informant is ready for testing.

Testing and Use. Plug an earphone into J1 and turn on S1. Select S2 for wideband reception. With the antenna extended, you should hear some sounds, and one or more LEDs will probably be lit. Rotate R9 and note the behavior of the display; you will note that you can control whether the LEDs are on or off. With LED1 just at the point of turning on, the receiver is adjusted for maximum sensitivity.

To test the unit further you will need an RF transmitter such as a cellular phone, cordless phone, baby-room monitor, FM wireless mike, walkie-talkie, or any other similar device. Hold the RF Informant away from yourself with the antenna vertical. Sweep the unit in an arc. You will see that there are two directions that have the strongest reading. If the signal gains strength as you move in the direction of the signal, you should be getting closer to the signal source. If the signal

weakens, reverse your direction.

Adjust R9 for a reading on the LEDs that is not "pegged" to the limit. Continue to head in the direction of the strongest signal. You might need to correct your heading by sweeping the RF Informant in an arc to get a new bearing. You should also monitor the signal with an earphone plugged into J1. You might need to adjust the antenna length to pinpoint the RF source if it is quite strong.

If you are getting too much interference on the wideband setting, selecting the highband setting with S2 will usually give better reception—especially from an FM transmitter. Note that sources of interference can include light dimmers and fluorescent lighting.

Experience is the key to effectively using the RF Informant. Practice with hidden transmitters so that you can become familiar with the controls and monitoring techniques. You'll be amazed at how many sources of RF there are around you!

POPTRONIX®

Online
Edition

We're on the web

FREE

We are starting up,
but you can watch us grow!

Projects for beginners
to experts!

New Product information!
Bookstore—discover
what's new!

<http://www.poptronix.com>

WE'RE WITH YOU EVERY DAY
24 HOURS A DAY! DROP IN!
WE'D LOVE TO HAVE YOU VISIT!

A Super-Safe Smart Crosswalk

Here's a new safety system that can keep you from getting that "run-down" feeling when crossing a busy street.

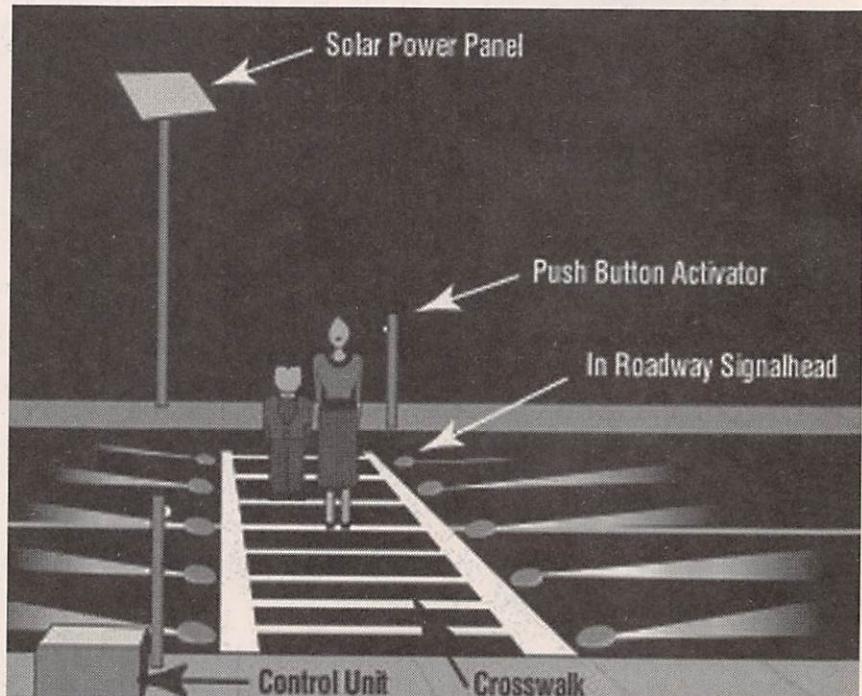
BILL SIURU

Crossing a busy street, especially at night, can be a dangerous affair, but it is also one that could soon be a lot safer. That's because the new "LightGuard System Smart Crosswalk" warning system makes it much easier for drivers to know when pedestrians are in a crosswalk. The system, from LightGuard Systems (LGS), Inc. (Santa Rosa, CA), works much like the flashing lights embedded in landing strips and taxi ways at airports. Indeed, this is where the system's inventor, Mike Harrison, a former commercial pilot, got the original idea.

The LightGuard System's flashing amber-color LED lights are embedded in the street on both sides of a pedestrian crosswalk. Installed so they face oncoming traffic, the lights can be seen by approaching motorists up to 1500-feet away. That greatly increases the warning that a driver has to step on the brakes, especially at night or in bad weather.

The warning system is automatically activated when a pedestrian passes between the Automatic Activation Bollards positioned near the crosswalk entrance zone. Those posts use break-beam technology that is already used extensively in industrial applications. The system determines the pedestrian's direction of movement and does not reactivate the warning when the pedestrian exits.

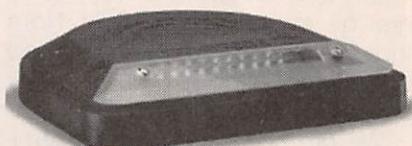
Pedestrians will not be aware of the activation, especially during daylight hours, but only that traffic is stopping. Pedestrians can also manually push buttons located on either side of the crosswalk. The flashing automatically shuts off after a set period of time, usually 15 to 20 seconds.



The lightguard system's flashing LED lights are embedded in the street on both sides of a pedestrian crosswalk. The flashing lights warn oncoming drivers to slow down and stop for a crossing pedestrian.

Design Considerations. Much effort went into selecting the right flash rate as well as light placement and aiming so that they get the attention of motorists and are visible down the entire motorist-viewing-path. The lights flash in unison at a pulse rate designed for maximum recognition. Challenges in getting the system right included making sure the lights were the right hue of amber and that they flickered in any direction, yet did not pulse at rates that might induce epileptic drivers to have seizures. Motorists say the strobe-like flash catches their eye without dangerously distracting them.

The amber LED provides good



The system's low-profile signal heads project only about 1/2 inch above the pavement. A version that is more snowplow-friendly is under development.

visibility in bright sunlight and in adverse weather, and the system is especially effective at night. Statistics show that pedestrians are 1100 times more likely to be hit by a car at night than during the day. Eight out of ten drivers who struck

(Continued on page 86)

SHOPPER

R

Robotics for the Next Millennium.

Exploring the New World of Science Kits.

OWI's "Next Generation" of affordable, rugged Robot Kits for the next millennium challenges the enthusiast to solder circuit boards and / or mechanically assemble.

Each OWIKIT also incorporates the basic principles of robotic experiments, sensing and locomotion, guaranteeing an exciting, hands-on adventure of knowledge and fun!

But remember! OWI is the recognized founder and leader in Educational Robot Kits. **ACCEPT NO IMITATIONS.**

Visit our homepage at www.owirobot.com

WAO-G	OWI-968K	Fuzzy Logic	68 Pg. Book	89.95
ROBOTIC ARM TRAINER	OWI-007	5 Axis Control	53 Pg. Book	69.95
TRIPLE ACTION SOLAR CAR	OWI-685	Solar Sensor	27 Pg. Book	39.95
S-CARGO	OWI-936K	Sound Sensor	47 Pg. Book	36.95
WAO II	OWI-961K	Programmable - Graphic	59 Pg. Book	69.95
SPIDER	OWI-962K	Infrared Sensor	49 Pg. Book	49.95
LINE TRACKER	OWI-963K	Infrared Sensor	48 Pg. Book	49.95
HYPER PEPPY	OWI-969K	Sound / Touch Sensor	46 Pg. Book	24.95
MOON WALKER	OWI-989K	Solar Sensor	10 Pg. Book	34.95

Be on the lookout for the new exciting

- Amphibious Solar Vehicle
- Remote Controlled Cyclone
- Infrared Sumo Robot

17141 Kingsview Ave., Carson, CA 90749
Phone: (310) 515-6800
Fax: (310) 515-1606
Toll Free: (877) 4-ELEKIT (353348)
E-mail: owi@ix.netcom.com
Web Page: www.owirobot.com

EK
ELEKIT

NEW
WAO-G
Fuzzy Logic Robot - Draw straight lines, circles and words; learn fuzzy control principles.

MasterCard VISA

Order M - F: 8a.m. - 4p.m. PST

ENGINEERS • EDUCATORS • HOBBYISTS • SCIENTISTS

EARN MORE MONEY!

Be an FCC LICENSED ELECTRONIC TECHNICIAN!



Learn at home in spare time.
No previous experience needed!

No costly school. No commuting to class. The Original Home-Study course prepares you for the "FCC Commercial Radio-telephone License." This valuable license is your professional "ticket" to thousands of exciting jobs in Communications, Radio-TV, Microwave, Maritime, Radar, Avionics and more...even start your own business! You don't need a college degree to qualify, but you do need an FCC License.

No Need to Quit Your Job or Go To School
This proven course is easy, fast and low cost! GUARANTEED PASS—You get your FCC License or money refunded. **Send for FREE facts now. MAIL COUPON TODAY!**

Or, Call 1-800-932-4268 Ext. 210

COMMAND PRODUCTIONS

FCC LICENSE TRAINING, Dept. 210
P.O. Box 2824, San Francisco, CA 94126
Please rush FREE details immediately!

NAME _____
ADDRESS _____
CITY _____ STATE _____ ZIP _____

www.unbound-tech.com

UTI 1-877-UNBOUND

Development Boards, Microcontrollers, Kits,
Control and Measurement

Development, Prototype and Testing

- **JCM Vulcan Logic Trainer:** Design and test digital circuits in minutes with this trainer and a breadboard. **\$32**
- **JCM Advanced dig daughterboard** **\$39**
- **JCM Analog Trainer:** Use on its own, or to complement to the logic trainer, test analog circuits in minutes. **\$45**
- **UTI PIC-Micro Trainer:** This system gives you the flexibility to test and experiment with micro based designs, includes a 64K-bit non-volatile E2 mem, and RS-232 and RS-485 drivers. **\$129**
- **UTI Control Trainer:** Real world interface for the trainer series, with inputs and outputs for measurement and control, analog cond. relays, buffered dig I/O, and more. **\$69**
- **UTI Cybug 1 kit:** a great little robot kit for the hobbyist **\$32**
- Prototyping breadboard to fit the above

Serial Control and Measurement

- **UTI-XX-232.485 Series:** measure Inputs and trigger events over serial, uses simple ASCII protocol **\$99-\$299**
- **UTI-05-XXX:** 0-5VDC 4 channel 8 bit A/D
- **UTI-DI-XXX:** 0-30VDC 4 channel digital input, adjustable trigger level
- **UTI-OC-XXX:** 8 channel open collector outputs, opt 5V pull-up, drive relays or solenoids
- **UTI-RE-XXX:** 4 SPDT relays w/ 2A contacts
- **UTI-PM-XXX:** 2 channel PWM output with two buffered digital outputs, good for motor control apps, opt H-bridge version.
- **UTI-WM-XXX:** ambient temperature and relative humidity, 8 bit resolution
- **More available....**
- **UTI-232-485:** Speak to an RS-485 device with your PC, extend 500' to other serial devices, or chain several UTI-XX-485 devices. **\$129**

Microcontroller Boards and Interfaces

These boards include voltage regulation, 64K-bit serial E², RS-232 and RS-485 drivers, interface with screw terminals and/or stackable expansion headers.

- **UTI-P76F:** A flash PIC micro dev board **\$169**
- **UTI-11A1:** A 68HC11 based SBC **\$189**
- Some interfaces available: **\$49-\$99**
 - 4 and 8 channel analog zero and span cct
 - 8 SPDT relays with 2A contacts
 - 2A dual H-bridge for motors and solenoids
 - Audio capture, 2-4 min of audio
 - Micro modem rates @ 2400 - 28.8
 - LCD, 2 line x 16 char, and 4 line x 20 char
 - Ambient temperature and relative humidity
- **UTI-I2CM-XXX-X:** Non-volatile I²C memory boards (up to \$12Kb per board!) **\$39**

Other Exciting Products

- **UTI-WC1:** Serial CCD Camera. Board level, takes serial commands through RS-232 at up to 115 K Baud, returns CCD data in various res. Great for pics and experimenting. PC S/W incl. **\$249**
- **UTI-SCL:** WinCam.Live. Serial port based webcam system for your PC. **\$499**
- **UTI-SCP:** SecureCam Pro. Remote access surveillance camera, event trigger, motion detection, outdoor encl. available **\$599**
- **UTI-ACC:** Capture and play 2-4 min of audio, line level input, dry contact trigger **\$129**
- **UTI-MP-XXX:** serial RS232 radios, 900MHz narrow band RF, ch selectable, 1000' range outdoor, combine with our control and measurement products for a telemetry system. **\$519**

*All prices in US\$

**Shipping and handling not included

We also provide affordable electronic design, consulting, assembly, and product development.



#25-1725 30 Ave NE Calgary, Alberta, CANADA T2E 7P6

Tel: 403-291-0054 Fax: 403-291-0017

Payment by Cash, Chk, MO, COD

Call us to receive details via fax, mail or email.

PICT'N Books

LEARN ABOUT PIC MICROCONTROLLERS

EASY PIC'N - Beginner

\$29.95

PICT'N Up The Pace - Intermediate

\$34.95

NEW!

PICT'N Techniques - Intermediate

\$34.95

- 8-pin PICs
- Timer 1, timer 2 and the capture/compare/PWM (CCP) module
- Talking to a PIC with a PC using a terminal program
- Test equipment and data logger experiments

See Table Of Contents: <http://www.sq-1.com>
Secure Online Ordering Is Available

+\$4 s/h in US for 1 book, \$5 for 2 books, \$6 for 3 books
VISA, MC, AMEX, MO, Check

CA residents please add 7.25% CA sales tax
PIC and MPLAB are trademarks of Microchip Technology Inc.

SQUARE 1 ELECTRONICS

P.O. Box 501, Kelseyville, CA 95451
Voice (707) 279-8881 FAX (707) 279-8883
Web Site: <http://www.sq-1.com>
E-Mail sqone@pacific.net

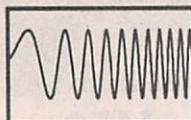
Any waveform you want!



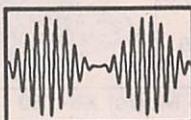
New Features:

- ✓ 21.5 MHz
- ✓ .01 Hz steps
- ✓ multi-unit phaselock

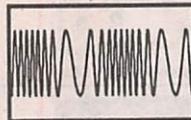
Telulex Inc. model SG-100A



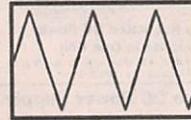
DC to 21.5 MHz linear and log sweeps



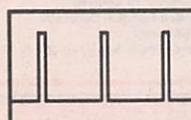
Int/Ext AM, SSB, Dualtone Gen.



Int/Ext FM, PM, BPSK, Burst



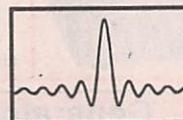
Ramps, Triangles, Exponentials



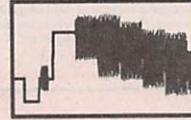
Pulse Generator



Noise



Arbitrary Waveforms



Unlimited Possibilities!

Telulex Inc.



2455 Old Middlefield Way S Tel (650) 938-0240 <http://www.Telulex.com>
Mountain View, CA 94043 Fax (650) 938-0241 Email: sales@Telulex.com

CIRCLE 312 ON FREE INFORMATION CARD

Network Service Tool Set

Popular installation and service tools for networks, modems and telephones. All hand tools are professional heavy duty type.

Use the compact tester on 10BASE-T (UTP & STP), thin Ethernet (BNC), 8-position Token Ring, AT&T 258A and EIA/TIA 568A/B. Automatically scans cables for continuity, wiring sequence and polarization. Tests STP cable ground. Testing installed cables is easy with Remote Terminator and gender changers (UTP and BNC). 9V battery included.

- Coax Stripping Tool, RG-58 & RG-59
- BNC Crimping Tool, RG-58 & RG-59
- Modular Cutting/Stripping/Crimping Tool (4, 6 & 8-Position)
- Multi-Network Cable Tester
- AC Receptacle Tester
- Cable Cutter

Order No. 55625 \$197.00



PC Service Tool Set

Contains all tools needed to troubleshoot & service IBM-compatible PCs. Set includes:

- AMI Diagnostic Software
- POST Card
- Logic Probe
- Digital Multi-Meter
- AC Receptacle Tester
- Serial Adapter
- Serial & Parallel Loopback Connectors
- DIP IC Puller
- PLCC IC Puller
- Grounding Wrist Strap
- Key Top Puller

Order No. 55000 \$198.00



PC Diagnostic Tool Set

- AMI Diagnostic Software
- POST Card

Order No. 55555 \$89.00

Network Installation Tool Set

- Network Tool Set 55625 without the Multi-Network Cable Tester.

Order No. 55600 \$99.00

Call for your FREE Catalog

Graymark®

P.O. Box 2015 Tustin, CA 92781

<http://www.labvolt.com>

CALL TODAY!

800-854-7393



CIRCLE 329 ON FREE INFORMATION CARD

CALL TOLL FREE
(800) 292-7711
Orders Only
Se Habla Español

C&S Sales

Look For Other
Monthly Specials
On Our Website

Excellence in Service

www.cs-sales.com

Power Supplies

Elenco Quad Power Supply
Model XP-581



\$79.95
4 Fully Regulated DC Power
Supplies in One Unit.
4 DC voltages: 3 fixed - +5V @ 3A, +12V @ 1A, -12V @ 1A
1 Variable - 2.5 - 20V @ 2A

Elenco Power Supply Kit
Model XP-720K



\$54.95
• 1.5VDC - 15VDC @ 1A
• -1.5VDC - -15VDC
• 5VDC @ 3A
• 6.3VAC @ 1A &
12.6VAC center
tapped @ 1A
XP-720 Fully Assembled \$85

Elenco DC Power Supply
Model SPL-603 **\$79.95**
3A 0-30VDC



The SPL-603 is a solid-state DC power supply providing the exact output voltage no matter what current you use. It contains one fully regulated power supply. The variable voltage is capable of delivering 0-30V at up to 3A. The output is precisely held to the desired output voltage by a special regulating circuit. Output fully protected from overload.

Miscellaneous

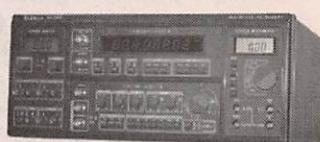
Elenco Model EP-50

Electronic Playground
and Learning Center
Contains Over 50
Experiments

\$19.95



Elenco Model MX-9300
Four Functions in One



\$450

Features:

- One Instrument with four test and measuring systems:
 - 1.3GHz Frequency Counter
 - 2MHz Sweep Function Generator
 - Digital Multimeter
 - Digital Triple Power Supply - 0-30V @ 3A, 15V @ 1A, 5V @ 2A

Generators & Counters

Elenco Sweep Function Generator
w/ built-in frequency counter Model GF-8036

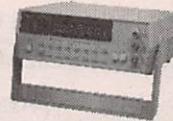


\$225

This sweep function generator with counter is an instrument capable of generating square, triangle, and sine waveforms, and TTL, CMOS pulse over a frequency range from 0.2Hz to 2MHz.

10 Function 1.3GHz Universal Counter
Elenco Model F-1300

\$225
• Frequency .05Hz - 1.3GHz 3 Ranges
• Period - Can read 60Hz to 60,000,000 F=1/T
• Totalize - Counts to 199,999,999
• RPM - 3 to 2099994 RPM
• Duty Cycle
• Math Functions
• Stopwatch set 2 sec. to 100 hrs.
• Math Functions
• Timer - 2 sec. to 99 days
• Pulse Width - 0.1ms to 6666.6ms



Multifunction Counter
B&K Model 1875
10Hz - 2.5GHz



\$189

Ultra sensitive
synchronous
detector bar-
graph and RF
strength.
3 Channels

Elenco Handheld
Universal Counter
10Hz - 2.8GHz
Model F-2800



\$99

Features 10 digit display, 16 segment
and RF signal strength bar-
graph.
Includes antenna, NiCad battery,
and AC adapter.

Kit Corner

over 100 kits available

Model AK-870

Radio Control Car Kit

\$24.95

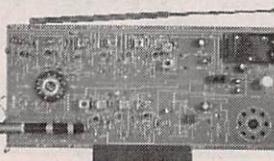


- Solderless
- 7 Functions
- Radio Control Transmitter Included

Model AM/FM-108K

AM/FM
Transistor
Radio Kit
w/ Stand

\$29.95



Model AK-700

Pulse/Tone
Telephone Kit

Ideal
School
Project



\$15.95

Elenco Digital / Analog Trainer

Model XK-700

Elenco's newest advanced Digital / Analog Trainer is specially designed for school projects. It is built on a single PC board for maximum reliability. It includes 5 built-in power supplies, a function generator w/ continuously sine, triangular and square waveforms, 1,560 tie point breadboard area. Tools and meter shown optional. (Mounted in a professional tool case made of reinforced metal).

XK-700
Assembled & Tested
\$189.95

XK-700K - Kit
\$159.95



Made in USA

Guaranteed Lowest Prices

UPS SHIPPING: 48 STATES 5%
OTHERS CALL FOR DETAILS
IL Residents add 8.25% Sales Tax

C&S SALES, INC.

150 W. CARPENTER AVENUE
WHEELING, IL 60090
FAX: (847) 541-9904 (847) 541-0710

15 DAY MONEY BACK GUARANTEE
2 YEAR FACTORY WARRANTY

PRICES SUBJECT TO CHANGE WITHOUT NOTICE



CIRCLE 322 ON FREE INFORMATION CARD

SAME DAY
SHIPPING

C&S Sales

Excellence in Service

CALL OR WRITE
FOR OUR
FREE

64 PAGE CATALOG!
(800) 445-3201

Digital Multimeters

**Elenco LCR & DMM
Model LCM-1950**



12 Functions
Freq. to 4MHz
Inductance
Capacitance
and Much More

\$69

Elenco Model M-1740



\$39.95

11 Functions:
• Freq. to 20MHz
• Cap. to 20 μ F
• AC/DC Voltage
• AC/DC Current
• Beep
• Diode Test
• Transistor Test
• Meets UL-1244 safety specs.
Model M-2760 - \$24.95
(9 functions)

Fluke 79III



\$185

• Capacitance ranges from 99.99nF to 9999 μ F.
• Built-in frequency counter of voltage input from 1Hz to over 20kHz.
• Lo-Ohm range, a 400 Ω range with Fluke's proprietary Zero Calibration, offers 0.01 resolution with increased noise rejection.
Series II (limited qty.)
\$179

Fluke 87III



\$299

Features high performance AC/DC voltage and current measurement, frequency, duty cycle, resistance, conductance, and capacitance measurement.

Series II (limited qty.)
\$289

Elenco Model LCR-1810



\$99.95

• Capacitance .1pF to 20 μ F
• Inductance 1 μ H to 20H
• Resistance .01 Ω to 2000M Ω
• Temperature to 750°C
• DC Volts 0 - 20V
• Frequency up to 15MHz
• Diode/Audible Continuity Test
• Signal Output Function
• 3 1/2 Digit Display

Elenco Model M-1005K



\$14.95

Digital Multimeter Kit
• 18 Ranges
• 3 1/2 Digit LCD
• Transistor Test
• Diode Test
M-1000B (Assembled) \$14.95

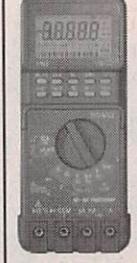
Dual-Display LCR Meter w/ Stat Functions



\$219.95

Auto/manual range
Many features with Q factor
High Accuracy

B&K Model 5390

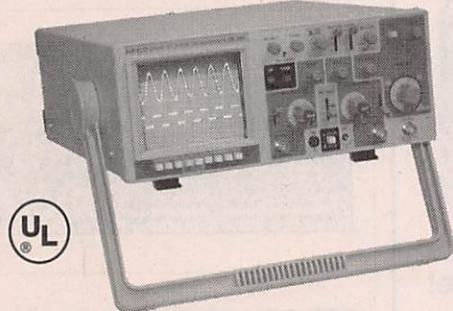


\$295

• 50,000 Count
• 0.025% DCV
• True RMS, AC or AC+DC
• 0.07% ohms
• 100kHz AC Response
• Autoranging, Bargraph with Zoom.
• Capacitance to 50,000 μ F
• Frequency, Duty Cycle, Pulse Width
• dB across 1 Ω to 10k Ω
• Disturbance Indicator

Oscilloscopes

Free Dust Cover and 2 Probes



S-1325	25MHz	Dual Trace	\$325
S-1330	25MHz	Delayed Sweep	\$439
S-1340	40MHz	Dual Trace	\$475
S-1345	40MHz	Delayed Sweep	\$569
S-1360	60MHz	Delayed Sweep	\$749
S-1390	100MHz	Delayed Sweep	\$995

DIGITAL SCOPE SUPER SPECIALS

DS-203	20MHz/10Ms/s	Analog/Digital	\$695
DS-303	40MHz/20Ms/s	Analog/Digital	\$995
DS-603	60MHz/20Ms/s	Analog/Digital	\$1295

Guaranteed Lowest Prices

UPS SHIPPING: 48 STATES 5%

OTHERS CALL FOR DETAILS

IL Residents add 8.25% Sales Tax

SEE US ON THE WEB

C&S SALES, INC.

150 W. CARPENTER AVENUE

WHEELING, IL 60090

FAX: (847) 541-9904 (847) 541-0710

www.cs-sales.com

15 DAY MONEY BACK GUARANTEE

2 YEAR FACTORY WARRANTY

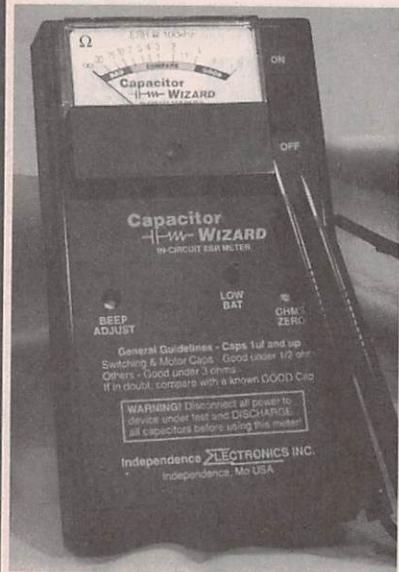
PRICES SUBJECT TO CHANGE WITHOUT NOTICE

Locate Bad Caps Fast

IN-CIRCUIT!!

Lower Costly Service Time
Reduce Costly Callbacks
Tame "TOUGH DOGS" in Minutes
INSIST on the ORIGINAL Capacitor WIZARD
IN-CIRCUIT ESR METER

Large, easy to read analog meter makes for the fastest, most accurate testing available! Unique "Cap GOOD" beeper makes testing caps in circuit virtually **INSTANTANEOUS!!** Needle sharp **GOLD PLATED** stainless steel probes provide **FAST** and **POSITIVE** connection to both **AXIAL** and **RADIAL** caps.



Technicians say the Capacitor Wizard is "the most cost effective instrument on their work-bench!"

ONLY \$179.95
800-394-1984

For More Information goto
www.heinc.com/ieinc/cwinfo.htm

30 DAY MONEY BACK GUARANTEE
Order today! You Can't Lose!!!

Made in the USA!



Howard Electronic Instruments, Inc.
6222 N. Oliver, Kechi, KS 67067
316-744-1993 International
316-744-1994 Fax
Email: sales@heinc.com



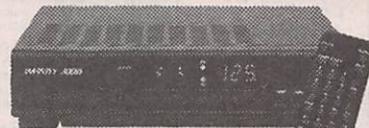
**Call Today And
SAVE!** **Unbeatable
PRICES!**

CABLE TV

**DESCRAMBLERS
CONVERTERS • FILTERS
VIDEO STABILIZERS**

- FREE** ➤ 30 Day Trial
- FREE** ➤ Product Catalog
- FREE** ➤ 1 Year Warranty

100% MONEY BACK GUARANTEE



*Let us point you in
the right direction ...*

Arrow
Technologies
Omaha, Nebraska

TOLL FREE
888-554-ARROW  
888-554-2776

ELECTRONIC COMPONENTS



Visit our web site!
www.mouser.com

Subscribe, download, or
view catalog online!

- Over 87,000 Products
- More than 145 Suppliers
- Same Day Shipping
- No Minimum Order

800-992-9943

817-483-6828 Fax: 817-483-6899
catalog@mouser.com

958 North Main St., Mansfield, TX 76063

Quality Microwave TV Systems

WIRELESS CABLE - IFTS - MMDS

ATV - INTERNATIONAL - DIGITAL

Amplifiers • Antennas • Books • Components

• RF Frequency 2100-2700 MHz

• SASE For "FREE" Catalog or Send \$1.

PHILLIPS-TECH ELECTRONICS

P.O. Box 3074 • Scottsdale, AZ 85267-3074

CATALOG/INFO: **480-947-7700**

ORDER LINE: **800-880-MMDS**

FAX LINE: **480-947-7799**

WEBSITE: www.phillips-tech.com

E-MAIL: product@phillips-tech.com

VISA • M/C • AMEX • DISCOVERY • COD'S • QUANTITY PRICING

CONTROL YOUR WORLD

32K HC11 ModCon

Low Cost Microcontroller boards & kits + Applications

ZORIN

<http://zorinco.com>
or call (206) 282-6061

BUGGED??

EAVESDROPPING is unbelievably widespread! Electronic Devices with amazing capabilities can be monitoring your telephone and room conversations RIGHT NOW! Are you sure you're safe? **FREE CATALOG** tells you fast! Includes Free Bonus details on fantastic opportunities now open in Counter-Surveillance field. Exciting, immensely interesting and **EXTREMELY** profitable (up to \$250 hr) full/part-time income. Call Now! **1-800-732-5000**

VIDEO SYNC GENERATOR



Restores Horizontal and Vertical Sync Lines from Distorted Video



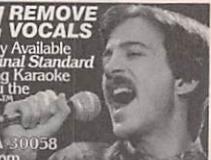
For Free Information Package and Pricing

Call (219) 233-3053
www.south-bend.net/rcd

R.C. Distributing, PO Box 552, South Bend, IN 46624

SINGERS! REMOVE VOCALS

Unlimited, Low Cost, Instantly Available Background Music from **Original Standard Recordings**. Does Everything Karaoke does... **Better and gives you the Thompson Vocal Eliminator™**. Free Brochure & Demo Tape. LT Sound Dept EN 7988 LT Parkway, Lithonia, GA 30058 Internet: <http://www.LTSound.com> 24 Hour Demo/Info Request Line (770)482-2485 - Ext 72 When You Want Something Better Than Karaoke!



!!! BROADCAST EQUIPMENT !!!

We manufacture & carry Stereo FM Transmitters, RF Amplifiers, Low Pass Filters, Antennas, DJ Mixing Boards & Consoles, Mics, Compressor/Limiters, Digital Reverbs, Automation Software, RF Test Equipment, RF Parts including BGY133's, and much more! Call for Free Catalog.

P BOX 586 STREAMWOOD, IL 60107
(630)736-9822 FAX: (630)736-0353



CABLE EQUIPMENT LOW, LOW WHOLESALE PRICES! **1-800-521-0512**

New 1-piece Jerrold-5 units \$109/ea; 10 u. \$99/ea; 20 u. \$89/ea.

New RFT-M - 5 units \$109/ea; 10 u. \$99/ea; 20 u. \$89/ea.

Basic Converter - 5 units \$75/ea; 10 u. \$65/ea; 20 u. \$55/ea.

WHOLESALE ELECTRONICS
Check out our website: www.whe.net

IS ANYBODY OUT THERE?

NEW, 2.4GHz VIDEO + STEREO AUDIO TRANSMITTER with SONY, CCM-PC5 COLOR CAMERA.

Originally sold for \$500! Now available for a fraction of that price. Great looking styling. Camera has a very stable, adjustable tilting base, front panel LED pwr. indicator and sensitive built in electret mic, providing excellent audio and video performance from one compact package. Simply connect camera to the completely self contained 2.4GHz transmitter. All cables supplied. You can transmit up to 700 feet clear line of sight! Companion matching receiver works with any TV or VCR. Internal patch antennas. Camera has adjustable focus 6mm lens. (1" to infinity, macro capable) Auto power off when the privacy shutter is closed. Power is 7-13VDC. (all pwr. adapters and cables included) 1/3" CCD, 330 Lines res. 35% better than standard VHS! Can also be used to transmit VCR output to another TV.

**SPECIAL 2.4GHz SONY-ASTROVIEW.... \$189ea. or 2 for \$339
2.4GHz TRANSMITTER & RCVR. only less camera..... \$129**

NOW YOU CAN SEE WHAT THE "FISHES ARE DOIN'" GO UNDERWATER (to 60 ft.) Waterproof B&W CAMERA & INTERNAL, INFRA-RED ILLUMINATOR!

Sleek black anodized, BRASS, housing is O-Ring sealed & WATERPROOF. Adjustable mount included. Specs: 1/3" CCD, 400 Lines resolution, 0.05 Lux sensitivity, AGC, Auto Shutter. Operates on 12VDC @225mA, 4mm, 78° FOV lens. A real glass lens. NTSC video out. Superior construction. SENSITIVE to IR. Ultra small size only: 1.25" diam. x 2" long. With 60 ft. cable. Great for general outdoor use also.

REG. \$299, GM-300KIR..... \$219

CHECK THIS! ULTRA MINI, WEATHERPROOF, COLOR too!

NEW "COLOR LIPSTICK" camera. For those applications that must be color, this is it. Black anodized, aluminum, housing is O-Ring sealed & RAINPROOF. Adjustable tilting mount included. Specs: 1/3" CCD, 400 Lines resolution, <1 Lux sensitivity, AGC, Auto Shutter. 12VDC @180mA, 4.3mm, 78° FOV lens. A real glass lens. Std. video out. Size: 32mm diam. x 65mm long. 24" leads with RCA jack and DC jack. Ready to go!

SPECIAL this MONTH, GM-400K...\$249, pwr. adpt...\$4.95

C-MOUNT LENS OPTIONS to ENHANCE YOUR IMAGE:

Fast Lenses for Low Light or General Purpose Normal Light

16mm, f1.6, 15° FOV \$39	4mm, 80° FOV \$24
8mm, f1.3, 40° FOV \$49	8mm, 40° FOV \$24
4mm, f1.4, 78° FOV \$49	12mm, 28° FOV \$24

6V@12AH SEALED, RECHARGEABLE, BATTERY

New Panasonic, LCR6V12PI. Tough to get at a discount. Very compact. Two top mounted 1/4" faston connectors. Perfect for high drain projects. Size: 5.9" L x 3.7" H x 1.9" D
2 for \$20, or 10 for \$89

10V @ 2.5 AH SEALED, LEAD ACID, PACK Each pack consists of five, 2 Volt cells. Each cell the size of a std. 'D' battery. Arranged as 1x5 cells. Enclosed in an ABS outer shell (removed for photo) Mint condition. Perfect for high drain and robotics applications. Make custom packs of any rating. Size: 7.5" L x 2.8" H x 1.5" D
5-five packs \$20, 30 for \$99

350MHz, TEK 485,

A superior performing O'scope, Dual Trace, Delayed sweep 1ns/div Sweep rate, 5mV Vert. sensitivity. Switchable input imped., 50 ohm / 1meg. Package includes 2 probes, cover and operation manual.

ORIG., \$9100ea. SPECIAL..... \$795



NEW, "STEALTH CAM", MICRO, with AUDIO!

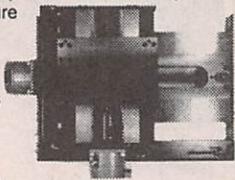
The sleek aluminum housing fits like a glove! Removable mounting bracket and a 1.3M cable with BNC vid., RCA aud. (internal mic) & DC barrel jack for, no sweat hook up. Why fool around with an open P.C. board? Now you can have the "STEALTH CAM". 1/3" CCD, 410 Lines, 0.3 Lux, AGC, Auto Shutter. Pwr. from 9 to 12VDC @110mA, 250k pixels, Std. model, 4mm, 78° FOV lens, Pinhole model, 90° FOV. A real glass lens. Focus from 10mm to infinity. NTSC video out. Only 1.7 ounce! SENSITIVE to IR. Size Std: 30mm sq. x 29mm d. PH is 16mm d. **WARNING: Don't confuse these models with LOW RESOLUTION, HIGH LUX C-MOS CAMERAS. GM-2000S-STD or Pinhole, w/audio..... \$79ea.**



DOVER AIR BEARING X/Y TABLES, ULTRA PRECISE,

Like New, The ultimate in precision motion. These are leadscrew operated air bearing tables with 1-20 Microns typ. repeatability. Straightness, <1 micron each axis, angular error, <1 arc/sec. Squareness, <5 arc/sec. Three models available. Model "A" has 6" x 6" travel with 2 type 23BLS-021-02, 4.85A 24V Rapidsyn stepper/encoders. Type "B" is as above without motors. Type "C" has 4" x 5" travel with two Compumotor LE57-51-MTR steppers. No controllers.

TYPE "A"...\$1200, TYPE "B"...\$949, TYPE "C"...\$849



NEW! 0.008lux, COLOR NIGHT VISION CAMERA!

UNBELIEVABLE LOW LIGHT PERFORMANCE.

Our GMV-2K, DOES it in COLOR TOO!



For covert, military and scientific applications that must be color, this is it. Performance is enhanced through low speed electronic shuttering and digital frame memory. With an auto iris lens, 24 hour monitoring is possible.

Auto sensitivity mode starts as it becomes dark. Eight Gain/Shutter modes are user selectable. Normal, X4, X8, X16, X24, X32, X64, X128. These provide frame rates of 60, 15, 8, 4, 3, 2, 1, and 0.5 frames per second. Auto/Manual white balance. Aluminum housing with dual 1/4x20 mounts. Specs: 1/3" CCD, with 291K pixels, 320 Lines, <1 Lux std. mode sens., 12VDC @200mA, Std. video out on BNC. Size: 54mm x 50mm x 94mm long. With pwr. adapter. All functions can be externally controlled via an 8 pin mini DIN. Uses std. c-mount lens not included.

Special Item, GMV2K..... \$589ea.

4mm, f1.4 A/I lens with custom cable..... \$99ea.

NEW! DAYLIGHT to LOW LIGHT MINI CAM, w A/I LENS

For those applications that must work from dawn 'till dusk, this is it. Rugged aluminum housing with dual mounting sockets. Specs: 1/3" CCD, 420 lines resolution, 0.1 Lux sens., AGC, Auto shutter. 12VDC @120mA. Take full advantage of camera sensitivity with the super, 4mm, f1.4, 78° FOV Auto Iris lens included. Video out on BNC. Size: 50mm sq. x 65mm long. Pwr. adpt. incl. Ready to go! **SUPER SPECIAL GM-510-A/I...\$199ea. or 2 for...\$369**



Please fax us your list of unique surplus material.

ULTRA MINI and WEATHERPROOF, "LIPSTICK" CAMERA

Sleek black anodized, alum. housing, O-Ring sealed & RAINPROOF. Adj. tilting mount. 1/3" CCD, 380 Lines, 0.3 Lux, AGC, Auto Shutter. 9-12VDC @100mA, 4mm, f1.8, 78° FOV real glass lens, NTSC video. <1ounce! IR SENSITIVE. 23mm x 50mm, 36" cable with BNC video & DC barrel jack. PINHOLE Model. So tiny you can install it directly into a door. Only a 0.9" diameter hole! Specs as above. 90° FOV Pinhole lens. 1/2 once! Size only 23mm d x 35mm long. Think of the places you could put this little jewel.

GM-200K-STD...\$119 or GM-200K-PH lens...\$119



RESOURCES UN-LTD.

300 BEDFORD STREET, MANCHESTER, NH 03101

VISA, MC, AMEX, DISCOVER, COD. ORDER: 800-810-4070 TECH. 603-668-2499 ORDER FAX: 603-644-7825 E-MAIL: united4u@juno.com



CIRCLE 283 ON FREE INFORMATION CARD

DIGITAL STORAGE OSCILLOSCOPES

WITH
SPECTRUM
ANALYZER,
DVM, FREQ.
COUNTER,
AND DATA
LOGGER.

from
\$189.

PORTABLE
MODULES
CONVERT PC'S
INTO
MULTIPURPOSE
TEST AND
MEASURING
INSTRUMENTS.



Why lug a scope around? Toss one of our modules into your laptop case or tool kit. For a multi-purpose test device, plug to a PC parallel port and use the PC screen. Continuous, delayed, or triggered sweeps can be frozen on the screen, printed out, or saved to disk. Frequency Spectrums DC to 25 MHz.

Allison now provides PICO TECHNOLOGY Ltd. portable test equipment, including high-speed scopes, and multi channel data loggers. Pico and O-Scope modules accept standard probes and work with 286 or faster PC's.

FEATURES:

- PORTABLE UNITS TO 25 MHz
- USES PRINTER PORT
- USES STD. PROBES

OPTIONS:

- PROBE SETS
- AUTOMOTIVE PROBES
- BATTERY PACKS
- SOFT & HARD CASES

O-Scopes Made in U.S.A.

Same Day Shipping
Includes Cable, Software & Manuals

O-Scope I (DC-50KHz, single trace)	\$189.
O-Scope II (DC-500KHz, dual trace)	\$349.
PICO (ADC 200/20) (DC-10MHz, dual trace)	CALL
PICO (ADC 200/50) (DC-25MHz, dual trace)	CALL

PICO pc based data loggers from \$99.

Shipping within U.S. UPS Ground \$7.50 (Second day \$11.50)

SEND CREDIT CARD INFO., M.O., or CHECK, OR CALL

1-800-980-9806

Allison Technology Corporation

2006 FINNEY-VALLET, ROSENBERG, TX 77471
PHONE: 281-239-8500 FAX: 281-239-8006

<http://www.atcweb.com>

TEKTRONIX 465M SCOPE



AN/ USM-425 militarized DC-100 MHz dual-trace oscilloscope with 8x10 CM display. Deflection 5 mv to 5 V/div in 10 calibrated steps, 1-2-5 sequence + vernier. Vertical modes: TRIG View, 20 MHz BW, CH 1, ALT, Add, Chop, CH 2 or X-Y. Sweep 0.05 usec to 0.5 sec/div in 22 steps + vernier; delay 0.05 usec to 50 msec/div. Also X10 magnifier, adjustable handle, front cover and manual copy. Requires 100-132/200-264 V 48-440 Hz; 7x1.7x21.5, 32 lbs sh. USED-CHECKED, \$475.00

30 FOOT MAST KIT

AB-1244/GRC MAST KIT, twelve aluminum alloy on steel sections form sturdy, yet lightweight 30 foot 1.7" dia mast. Kit includes five each lower and upper sections, one ea lower and upper adapter sections, gin pole swivel base, four ea 36 and 42 ft guy ropes, four guy stakes, two guy rings plus a 2.5 pound sledge hammer. Part of OE-254 antenna set; 30 lbs shpg NEW, \$139.50



400 MHZ RADIOSONDE

VAISALA RS80 RADIOSONDE, ultra-light disposable transmitter (400 MHz approx) is designed to be carried aloft by weather balloon and transmit data for air temperature, barometric pressure and humidity to a ground station. Consists of circuit board, dipole antenna, and trailing wire. Requires 9 V battery. Cute experimenter item! 12.5" H as shown; 3 lbs sh. NEW, \$9.95 ea; 5 for \$42.50

Prices F.O.B. Lima, Ohio. VISA, MASTERCARD, DISCOVER
Allow for shipping charges. Write for latest Catalog.
Address Dept. ES Phone 419/227-6573 FAX 419/227-1313
E-mail: fairadio@wcoil.com <http://www2.wcoil.com/~fairadio>

FAIR RADIO SALES

1016 E. Eureka Box 1105 Lima, Ohio 45802

LASERS

AT GREAT PRICES

Complete Ruby Laser Assembly less than \$300
He-Ne Lasers, complete, for less than \$50
American 60X Argon Lasers from \$595
Laser Diode Modules from under \$40
X-Y Scanners from \$79

FREE CATALOG

- Helium-Neon
- Argon Lasers
- Diode Lasers
- Holography
- Books
- Ruby Lasers
- Scanners
- Lightshow Equipment
- Pointers
- Optics

Email: mlp@nlenx.com <http://www.midwest-laser.com>

Midwest Laser Products

30 Day Satisfaction
Guarantee.
P.O. Box 262, Frankfort, IL 60423 VISA / MC Accepted
Phone: (815) 464-0085 FAX: (815) 464-0767

PCBoards

PCB Artwork Made Easy!

PRINTED CIRCUIT DESIGN SOFTWARE For Windows and DOS

Layout - Autorouting - Schematic - Circuit Simulation

- * 16 and 32 bit version available
- * Ripup and Retry Router in Advanced Pkg.
- * Copper Flooding for Building Ground Areas
- * Gerber and Excellon Output
- * Create Negative & Positive Printouts
- * Create Single or Multi Layer Boards
- * Create artwork from the Schematic
- * Analog and Digital Simulation available
- * Make boards up to 32" x 32"
- * Parts Libraries - Silk Layers - Solder Mask
- * For the Professional and Hobbyist!

Download DEMO - www.pcboards.net**Windows LAYOUT pgm. starts at****\$149****Windows Pkg. layout-schematic-router****\$399****DOS pcb layout - \$49.95****Call or Write for Full Product Line, Prices & Free Demo****PCBoards****(800)473-7227**2110 14th Ave. South
Birmingham, AL 35205Fax (205)933-2954
Phone (205)933-1122

CONTROL RELAYS • LIGHTS • MOTORS MEASURE TEMPERATURE • PRESSURE • LIGHT LEVELS • HUMIDITY INPUT SWITCH POSITIONS • THERMOSTATS • LIQUID LEVELS

MODEL 30 \$79

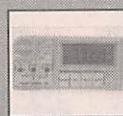
- PLUGS INTO PC BUS
- 24 LINES DIGITAL I/O
- 8 CHANNEL-
- 8 BIT A/D IN
- 12 BIT COUNTER
- UP TO 14K SMP/SEC

MODEL 45 \$189

- RS-232 INTERFACE
- 8 DIGITAL I/O
- 8 ANALOG INPUTS
- 2 ANALOG OUTPUTS
- 2 COUNTERS-24 BIT

MODEL 100 \$279

- 12 BIT 100 KHZ A/D
- 4 ANALOG OUTPUTS
- 3 TIMER COUNTERS
- 24 DIGITAL I/O

MODEL 150-02 \$179

- RS-232 INTERFACE
- TRMS, 20 AMPS
- 12 BIT A/D
- OPTO-ISOLATED
- COMPLETE DMM

MODEL 40 \$109

- RS-232 INTERFACE
- 28 LINES DIGITAL I/O
- 8 ANALOG INPUTS
- PWM OUTPUT

MODEL 70 \$239

- RS-232 INTERFACE
- 18 BIT A/D
- 5.5 DIGIT
- UP TO 60 SMP/SEC

Prairie Digital, Inc.

PHONE 608-643-8599 • FAX 608-643-6754

920 SEVENTEENTH STREET • PRAIRIE DU SAC, WISCONSIN 53576

SATISFACTION GUARANTEED NETCOM since 1983**ICMaster**
\$195 Publisher**Bible**
of the IC Industry
Every Cross-reference
3 Volume Set with Tons of Informationwith computer alone regular
\$29.95 edition \$49 \$69
\$39.96 edition \$59 \$89
\$49.97 edition \$69 \$109
Mega Sale ends soon2 Easy payments of
\$325!
On Credit Cards only**Oh-My-God!**
buy a computer,
get an **ICMaster**
\$29!

Racy & Web Ready IBM THINKPAD 486 DX4-100

Huge 10.5" Active Matrix Display
(Sharper, Brighter than a standard display)

1 Gigabyte Hard Drive / 24M Ram

33K FAX MODEM

Sound & Built-in Microphone

2-PCMCIA Expansion Slots

Infrared Port / Floppy

Track Point Mouse

All Standard Ports (1S, 1P, 1VGA, 1Kbd)

Hard Drive & Memory

Expandable & Upgradable

Includes Power Supply & Battery

Internet Ready / W95

Ask About

Desktop Docking Station Option

orig
\$2,899

The Screamer IBM THINKPAD Pentium P-75

2 Easy payments of
\$478!
On Credit Cards onlyorig
\$3,495Car Power Adapter
Runs ANY Laptop
\$69 with purchase**\$99** alone2 Gigabyte Hard Drive
Includes 24X Desktop External CD Rom
all other features same as the IBM DX4-100

Ask about Desk Top Docking Station Option

Notebook Attache
\$49 with purchase**\$69** alone**\$139** in Office Max

Contents NOT included

IBM Warrior

Maximum Abuse
orig
\$4,699
Credit Cards only**IBM Warrior**2 Easy payments of
\$399!
Credit Cards onlyDROP 3' to CONCRETE
OUTDOOR DIRECT SUNLIGHT
Rain Storm or Desert!Silicone Rubberized & Die Cast Case!
Ultra Shock Mounted 1GIG EIDE Hard Drive!
INSTANT ON! ZERO BOOT UP TIME!!!!
PCMCIA, Serial & Parallel Ports in rear / 3.5 Floppy
16m Ram / 1m Video / Local Bus 486DX50 & Math Co
28.8k Modem (Internet Ready), Speaker Phone
4+hours Battery Operation! / Sound & Microphone
8.25" Display-256 Shade Monochrome REFLECTIVE
Optional Touch Screen with Handwriting Recognition
Roxanne's Voice Annotates all Windows 3.X Functions
Unit Compatible with W95 / Optional 12V Car cord \$29

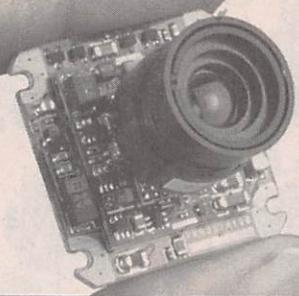
Questions 843-650-5700

Orders Only 800-733-3733

email netcom@aol.com 10-8 EST

FAX 843-650-5777 7 Days

Micro Video Camera Sale



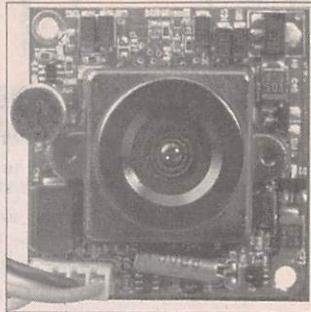
MB-45cB
Color Video Camera
2.8mm Lens
45° Angle of View
\$99.95

Size: 1.25" sq.



MB-650Ua
Black & White Video Camera with Built-In Audio & 4.3 mm Lens.
\$89.95

Size: 1.18" sq.



Wireless Cameras

Wireless Camera Package Deals, include: one camera, one receiver and power supplies. (Receiver holds up to 4 cameras)

Wireless 4-Channel A/V Black/White & Color Cameras



Built-in Mic
(on All models)
Cameras are shipped with 4.3mm lens.
(Camera shown with optional lens.)

GFS-1001 (900MHz)
GFS-2002 (1.2GHz)



LP-850p
\$139.95



Length: 1.37"
Diameter: .87"

Outdoor Model Available \$169.95

LP-850i
\$129.95

Length: 1.9"
Diameter: .91"



Polaris Industries

<http://www.polarisusa.com>

800.752.3571

Polaris Industries 470 Armour Dr. Atlanta GA 30324 Tech Info: 404.872.0722 FAX: 404.872.1038

FREE
Polaris Product Catalogs

\$499.
Stand Alone System
No PC Needed.



Interfaces with existing Camera Systems!

System includes:

- Monitor
- Camera/100 ft. Cable
- Camera Stand/Mount
- 2-way Intercom Station
- 100 ft. Intercom Cable
- VCR/Interconnect Cable
- One Year Warranty

SCO-1 - \$399.95
Observation System



NEW

SCO-1 - \$399.95
Observation System



FREE!

PHONE, FAX, WRITE
OR E-MAIL WITH YOUR
MAILING ADDRESS
MUST MENTION
OFFER "LAB-199"

PRE-PUNCHED END PANELS
9 BOX SIZES
25 PREPUNCHED
END PANELS

ALSO IN STOCK AT:

JENSEN TOOLS: 800-436-1194
MCB ELECTRONICS: 800-543-4330
TECH AMERICA: 800-442-2271

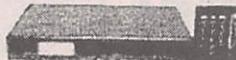
ALL ALUMINUM CONSTRUCTION
OFFER GOOD ONLY IN THE 48 STATES. ENDS DECEMBER 30, 1999. LIMIT ONE
REQUEST PER CUSTOMER. MAILED 1ST CLASS. ALLOW 1-2 WEEKS FOR DELIVERY

LOW COST

OFFICE: 702-585-8100 • FAX: 702-565-4828
www.sescom.com • info@sescom.com

SESCOM, INC. 2100 WARD DR. HENDERSON, NV 89015
SESCOM, INC. is not responsible for inadvertent typographical errors
and prices and specifications are subject to change without notice.

CABLE TV BOXES



(WE'LL BEAT ANY PRICE!)

30 DAY TRIAL* 1YR. WRNTY *FREE CATALOG
QTY. DISCOUNTS * DEALERS WELCOME!

1-800-538-2225

HABLAMOS ESPANOL



<http://www.tvcableboxes.com>

GLOBAL ELECTRONICS INC.

Battery Analyzer



PC-Controlled Battery Analyzer
Cycle, Charge & Test with your PC
Print reports, plot graphs, expandable

\$398



Tel: 800-673-3585

519-472-5566

Fax: 519-472-1702

Download Demo:

<http://home.rogerswave.ca/lamantia>
lamantia@compuserve.com

"Get the skills you need at a price you can afford!"

Earn up to \$45 an hour or more as a skilled Computer Programmer.

Cash in on the explosion of opportunities. Start your new career or even open a business of your own as a highly-paid computer programmer.

Computer programmers today can almost write their own ticket to financial well-being and job satisfaction. Only Foley-Belsaw's unique in-home training programs can give you the skills you need at a price you can afford.

You'll learn the three hot computer languages — QBasic, C and Visual Basic. You'll even work with the hot new C++. With this easy-to-learn knowledge, you'll write your first QBasic program by the end of the first SkillPak of lessons. Soon you'll be programming sound and graphics, and even learning how to program for the Windows environment — the most popular application program today.

It's easy to cash in!

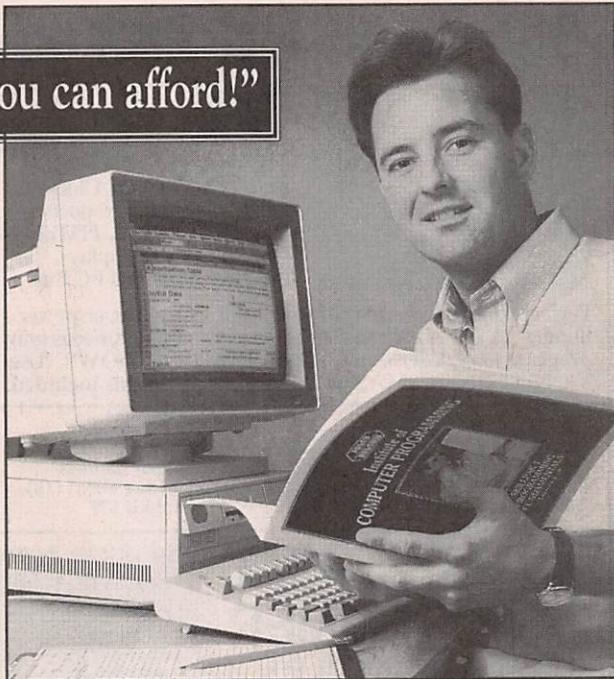
Look at some of the things professional computer programmers do. "Wrote a C program to clean up a WordPerfect file; edited the resulting file as data errors were found." This work would take a trained programmer less than five hours to complete, and they could make over \$200 for the work. That's money you could be making — and soon — with training from the Foley-Belsaw Institute of Computer Programming.

Everything is included!

We provide you with all the materials you'll need to become a professional computer programmer. You'll receive 37 lessons, designed for you by the Foley-Belsaw Professional Programmer Staff. Other valuable materials include a *Programmer's Handbook*, *Programmer's Examples* on two 3.5 inch disks, *Programmer's Flowchart Template*, and a booklet, *Selecting the Right Computer*.

Other schools force you to buy a complete computer package as part of their training program. At Foley-Belsaw we understand that your needs as a programmer may not fit into a "one size fits all" approach. Why should you pay hundreds of dollars for a computer system that you may not need?

We'll tell you what you need to know so that when you're ready to buy your own computer, you can get the machine that fits your needs at the lowest possible price. That's the Foley-Belsaw way.



Get the free facts today.

Whether you want to change careers, have a profitable part-time job or start your own business, Foley-Belsaw Institute's new computer programming course is the first step. A profitable future in computer programming can be yours. Call or write today for a fact-filled information kit including a free copy of *Computer Programming — A Profitable Career In Your Spare Time*. See how easy it is to begin a money-making career as a sought-after computer programmer. Our free full-color information kit outlines the steps of the computer programming course and shows you everything you will receive as part of your training.

Mail this coupon or call today
Toll Free 1-800-487-2100!

Your free opportunity kit will be rushed to you!

If coupon is missing, write to: Foley-Belsaw Company, 6301 Equitable Road, Kansas City, MO 64120

Call or complete & return this coupon to: Foley-Belsaw Institute, 6301 Equitable Road, Kansas City, MO 64120

YES! Rush me a free information kit on Computer Programming right away. Dept. 35664

Other career courses:

- Locksmithing, Dept. 13245
- Small Engine Repair, Dept. 53115
- Saw & Tool Sharpening, Dept. 22046
- VCR Repair, Dept. 62946
- Computer Repair, Dept. 64855
- TV/Satellite Dish Repair, Dept. 31717
- Gunsmithing, Dept. 92755
- Woodworking, Dept. 43978
- Upholstery, Dept. 81650
- Vinyl Repair, Dept. 71555
- Electrician, 95525
- Computer Specialist, Dept. 38482
- Networking Specialist, Dept. 39469

I understand that there is ABSOLUTELY NO OBLIGATION and NO SALESMAN WILL CALL.
Name _____

Address _____

City _____ State _____ Zip _____



PC
PLACE

386 MINI-PC \$83

1K PRICE
EVAL \$295
8088 \$27



includes:

- 5 Serial, 3 Parallel (32bit max)
- Up to 8 meg ROM (27C080)
- 32k RAM exp. to 64Mbyte
- Battery backed RT Clock
- LCD and Keyboard ports
- IRQ x15, DMA x2, TIMER x4
- On-board LED display
- Industry Standard PC Bus

Perfect when a full-size PC is too large, expensive, or power hungry. A fully functional single board computer, needs only program and power source. Runs DOS / WINDOWS. Use Turbo C, BASIC, MASM. All utilities to do this included.

A to D D to A CONVERTERS

For PC or SBC
8,12,16 bit resolution
up to 24 channels
starting at \$21 OEM (1k)
eval kit \$75

\$95 UNIVERSAL PROGRAMMER



FLASH, EEPROM, NVRAM, EPROM
up to 8 meg (27C64-080). Adapters for
micros, PLCC, etc. Parallel port version
for notebook. FAST AND EASY TO USE.

LOW COST... LOW POWER...

LOW RISC!

QTY 1K PRICE
\$1.99
EVAL KIT 7.00

LOWER COST, FASTER, EASIER TO PROGRAM SINGLE CHIP COMPUTER
COMPARE: 16C54 MV1200

OEM (1K) PRICE	16C54	MV1200	PINOUT:
RS232 PROGRAM DOWNLOAD	NO	YES	RESET 1 20 VCC
SINGLE CHIP OPERATION	NO	YES	P00 2 19 PB7
BUILT-IN BASIC	NO	YES	P01 3 18 PB6
EEPROM DATA MEMORY	NONE	64	XOUT 4 17 PB5
PROGRAM MEMORY	768 OTP	1K FLASH	XIN 5 16 PB4
MATH REGISTERS	1	32	PD2/INT 6 15 PB3
MAX INSTRUCTIONS / SEC	5M	20M	PD3 7 14 PB2
MAX COUNTER BITS	16	18	PD4/TMR 8 13 PB1/AD1
INPUT / OUTPUT BITS	12	15	PD5 9 12 PB0/AD0
A TO D COMPARATOR	NO	YES	GND 10 11 PD6
HARDWARE INTERRUPTS	NONE	3	
- LONG WORD INSTRUCTION - FRIENDLY SYMMETRIC ARCHITECTURE -			



PC SOLID STATE DISK
\$21
OEM (1k) eval kit 75.00
FLASH / RAM / EPROM
256K-16M PCMCIA/DIPS

No More Hangups...

PC WATCHDOG!
Reboots PC OEM \$21 EVAL \$75

VGA LCD
640x480 controller
for PC or SBC
\$27 OEM \$95 eval
combo LCD/CRT
version available



visit our web site: www.mvsweb.com

MVS BOX 850
MERRIMACK, NH 03054
(508) 792-9507

MVS

5yr Limited Warranty
Free Shipping
Hrs: Mon-Fri 10-6 EST

Learn MICROCONTROLLERS EMBEDDED SYSTEMS and PROGRAMMING...

...with the AES learning system/

embedded control system.

Extensive manuals guide you

through your development

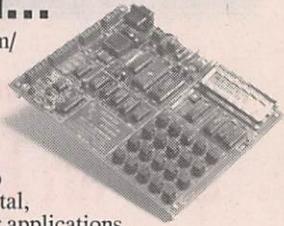
project. All programming and

hardware details explained.

Complete schematics. Learn to

program the LCD, keypad digital,

analog, and serial I/O. for your applications.



THREE MODELS AVAILABLE. Choose from an
Intel 8051, Intel 8088, or Motorola 68HC11
based system. All models come with:

• 32K Byte ROM, 32K Byte RAM • 2 by 16 Liquid Crystal Display • 4
by 5 Keypad • Digital, Analog, and Serial I/O • Interrupts, timers, chip-
selects • 26 pin expansion connector • Built-in Logic Probe • Power
Supply (can also be battery operated) • Powerful ROM MONITOR to
help you program • Connects to your PC for programming or data
logging (cable included) • Assembly, BASIC, and C programming
(varies with model) • Program disks with Cross Assembler and many,
well documented, program examples • User's Manuals: cover all details
(over 500 pages) • Completely assembled and ready to use • Source
code for all drivers and MONITOR • Optional Text Book

Everything you need. From \$279.
Money Back Guarantee

Call for Free Info Pack, or see
WEB at <http://www.aesmicro.com>
714-979-1091, FAX 714-979-1093

AES
Advanced Educational Systems

Call 1-800 -730-3232

AES MICRO, INC., 2110 S. LYON ST., SUITE C, SANTA ANA, CA 92705, USA

CAD FILES TO CASH PILES

IMAGINE THE POSSIBILITIES!

STARTING AT
\$895.00

NOW YOU CAN

TURN YOUR
DREAMS
INTO

REALITY!

THE **ROBOPRO X50**
CNC ROBOTIC MACHINING SYSTEM

YOUR WISH IS ITS COMMAND!

ROUTE, MILL, DRILL, CARVE,
ENGRAVE, PAINT, ETC. . .
IN WOOD, PLASTIC, VINYL,
PC BOARD, & LIGHT METALS

FREE 3D



CAD/CAM

U.S. CYBERLAB, INC., 14786 SLATE GAP ROAD
WEST FORK, AR 72774 (501) 839-8293

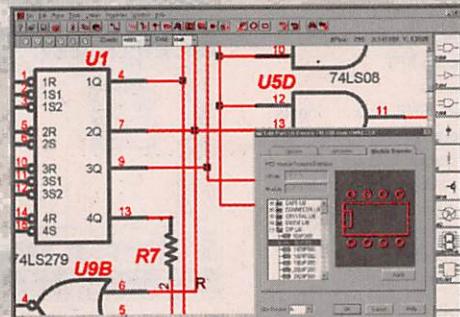
Visit us at www.uscyberlab.com

Electronic Design Automation for Windows

More Features More Power Less Money

Ivex 650 pin versions have no feature limitations like other low cost products on the market. Ivex WinDraft and WinBoard are the preferred choice for designers worldwide.

Take the Ivex challenge today. Try WinDraft Version 3.0 schematics for 30 days. We know you will find it to be the most powerful, full featured tool available. Guaranteed or your money back !



WinDraft®

Schematics **\$250**
650 pin version

Full Featured Tools:
Hierarchical designs
Part scaling
Step & repeat
True-type text
Auto junction
Single click editing
Rubberbanding
Graphical part editor
Update parts
Global replace
Advanced Bill of Materials with sort options.
User Definable
Electrical Rules Check
Annotation
Common netlist formats:
(Accel, Protel, Pads, Pcad, Tango, wirelist, spice, etc.)
Import Orcad/SDT sheets/libraries
Assign net signal properties for PCB layout
Visual PCB footprint browser
Over 10,000 parts included
Windows 95/98/NT

WinBoard®

PCB Layout **\$250**
650 pin version

Easy to install:
Multi layer designs (16)
Surface mount designs
Advanced Design Rule Check
Electrical DRC check and Real-Time DRC
Rotate and mirror
Single click editing
Pad stack editor
Global edit
Graphical part editor
Hundreds of footprints
Copper zone pour
Uses common netlist formats
Edit netlist on the fly
Output Gerber photo plot files
NC drill report
Bill of materials
Free web support

Ivex View

Gerber Viewer **\$99**
Any size file

View and print any size file in standard Gerber 274-x format and most 274-D.

Visit the Ivex web site for complete product information and free product demos.



www.ivex.com



DESIGN
INTERNATIONAL

Telephone: (503) 531-3555
e-mail: sales@ivex.com

ADV5_1

Turn Your Multimedia PC into a Powerful Real-Time Audio Spectrum Analyzer

Features

- 20 kHz real-time bandwidth
- Fast 32 bit executable
- Dual channel analysis
- High Resolution FFT
- Octave Analysis
- THD, THD+N, SNR measurements
- Signal Generation
- Triggering, Decimation
- Transfer Functions, Coherence
- Time Series, Spectrum Phase, and 3-D Surface plots
- Real-Time Recording and Post-Processing modes

Applications

- Distortion Analysis
- Frequency Response Testing
- Vibration Measurements
- Acoustic Research

System Requirements

- 486 CPU or greater
- 8 MB RAM minimum
- Win. 95, NT, or Win. 3.1 + Win.32s
- Mouse and Math coprocessor
- 16 bit sound card

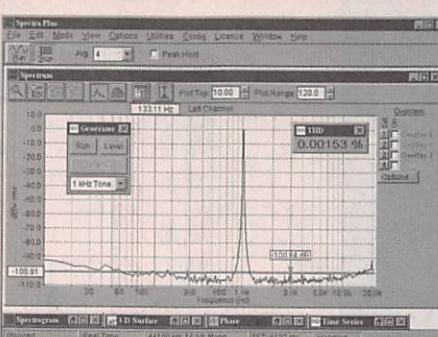
PHS Pioneer Hill Software
a subsidiary of Sound Technology, Inc.

Sales: (360) 697-3472

Fax: (360) 697-7717

Spectra Plus
FFT Spectral Analysis System

e-mail: pioneer@telebyte.com



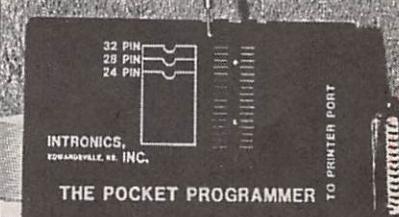
Priced from \$299

(U.S. sales only – not for export/resale)

DOWNLOAD FREE 30 DAY TRIAL!

www.spectraplus.com

The Pocket Programmer Only \$129.95



THE POCKET PROGRAMMER

The portable programmer that uses the printer port of your PC instead of a internal card. Easy to use software that programs Eprom, EEPROM, Flash & Dallas Ram. 27(C) / 28(C) / 28F / 29F / 29C & 25XX series from 16K to 8 Megabit with a 32 pin socket. Adapters available for Pic, PLCC, 5-Gang, 874X, 875X MCUs, 40-Pin X 16 & Serial Eprom's, 82/74 Prom's and Eprom Emulator to 32K X 8.

Same Name, Address & Phone # for 16 Years... Isn't it Amazing ?

Intronics, Inc.

Box 13723 / 612 Newton St.
Edwardsville, KS 66113 Add \$5.00 COD
Tel. (913) 422-2094 Add \$4.00 Shipping

Fax (913) 441-1623 Visa / Master Charge



Intelligent Database for Equipment Maintenance

If you repair equipment for a living you need Expert One!
You can reduce repair time and make better fixes!

Expert One stores hundreds of concepts, rules, procedures and history records. You determine what information to input. Use scanned documents, typing, or batch feed information to E1. During troubleshooting you select symptoms and Expert One makes recommendations about what will fix the problem!

Get answers to real-world troubleshooting questions:

- * What is this part?
- * What components are in this part?
- * What are the capabilities of this part?
- * Where is a certain part located in a machine?
- * Is this part similar to another part?
- * Which troubleshooting rules apply?
- * What's the history of this part?
- * What procedures can fix the problem?

14 Day Trial and Demo CD available
Glendale Software Company

www.glensoft.com

Phone/Fax: 623-939-6522

\$199.95

+tax & shipping

Major Credit Cards Accepted

PROGRAMMERS OVER 50 MODELS

ADVANTECH EETOOLS NEEDHAMS DATA I/O ICE TECHNOLOGY HILO SYSTEM GENERAL CHROMA MODULAR CIRCUIT TECHNOLOGY XELTEK



PROMAX	EMP-20	MEGAMAX	MEGAMAX 4	SIMM/SPI TESTER	EMUPA
CALL	ADVANTECH LABTOOL	599	EETOOLS SIMMAX		
629	ICE TECH MICROLV	795	CHROMA SIMM/SPI		
650	EETOOLS ALLMAX +	359	MOD-MCT-EMUPA/R		
409	EETOOLS MEGAMAX	279	MOD-MCT-EMUP/R		
509	EETOOLS MEGAMAX 4	49	EPROM 1G TO 512K		
369	XELTEK SUPERPRO II	69	EPROM 1G TO 1MEG		
409	XELTEK SUPERPRO II P	99	EPROM 4G TO 1MEG		
249	XELTEK SUPERPRO L	199	EPROM 16G TO 1MEG		
165	XELTEK ROMMASTER II	89	EPROM 1G TO 8MEG		
479	MOD-MCT-EMUPA	129	EPROM 4G TO 8MEG		
739	STAG ORBIT-32	250	EPROM 8G TO 8MEG		



LABTOOL48 MICROMASTER SUPERPRO ALLMAX PLUS ROMMASTER2

General Device Instruments

Sales 916-393-1655 Fax 916-393-4949 BBS 983-1234

Web www.generaldevice.com E-Mail icdevice@best.com

Data Acquisition and Control

The ADR series of interfaces allow control of analog, digital and relay I/O via RS232 or RS485. Visit the web site for specs, applications and programs in VB, C, BASIC etc. (705) 671-2652

www.ontrak.net

Ontrak Control Systems Inc.



EPROM+

A device programming system for design, repair and experimentation

- ◆ EXCEPTIONAL POWER FOR THE PRO
- ◆ EASY-TO-USE FOR THE NOVICE
- ◆ INCLUDES STEP-BY-STEP TUTORIAL

Here's what you get: A rugged, portable programming unit including the power pack and printer port cable both of which store inside the case. A real printed user and technical manual which includes schematic diagrams for the programming unit plus diagrams for all technology family adapters.* Comprehensive, easy-to-use software which is specifically designed to run under DOS, Windows 3.1, 95 and 98 on any speed machine. The software has features which let you READ, PROGRAM, COPY and COMPARE plus much more. You have full access to your system's disk including LOADING and SAVING chip data plus automatic processing of INTEL HEX, MOTOROLA S-RECORD and BINARY files. For detailed work the system software provides a full screen buffer editor including a comprehensive bit and byte tool kit with more than 20 functions.

Broad device support: FIRST GENERATION EPROMS (2708, TMS2716*, 25XX) SECOND GENERATION EPROMS (2716-28C080), 40 AND 42 PIN EPROMS* (27C1024-27C160) FLASH EPROMS (28F29E, 29E, 29F), EEPROMS (2816-28C010), NVRAMS (12XX, X2210/12) 8 PIN SERIAL EEPROMS* (24, 25, 85, 93, 95, 8001A) PLUS ER1400/M58657* AND ER5901 BIPOLEAR PROMS* (72S/82S), FPGA CONFIGURATORS (17XXX) MICROCONTROLLERS* (874X, 875X, 87C5XX, 87C75X, 89C5X) ATMEL MICROS* (8-40) PIN 89C051, 89SXXX (AVR) 90SXXX PIC MICROS* 8, 18, 28, 40 PIN (12XXX-16XXX, 16FXX, 17C) MOTOROLA MICROS* (68705P3/33R3, 68HC705, 68HC711)

*REQUIRES SNAP-IN ADAPTER (ORDER FACTORY DIRECT OR BUILD YOURSELF)

1 YEAR WARRANTY - 30 DAY MONEY BACK GUARANTEE VISA•MASTERCARD•AMEX

ANDROMEDA RESEARCH, P.O. BOX 222, MILFORD, OH 45150
(513) 831-9708 FAX (513) 831-7562 website - www.arlabs.com

\$289

FREE

128 page full color catalog!

Dealers/Resellers ask about our
SmartHome PRO Dealer Program 800-949-6255

Take a step into the future -- discover the latest in innovative home technology, from remote controls to high-tech toys to voice-activated systems. We will show you the *smart* (and easy!) way to automate your home.

Lowest Prices Guaranteed!

Call 800-SMART-HOME
800-762-7846

or visit us on the web @
smarthome.com
to order your **FREE** catalog today!

Order 24 Hours • 7 Days

**HOME AUTOMATION
SYSTEMS, INC.**

Hexapod Walker Kit \$150.00 Plus S&H



You can build this Hexapod Robot

This easy to build robot really walks using an alternating tripod gait. It can walk forward, reverse, and turn on a dime, left or right. With a payload of more than 12 oz., this robot is a real workhorse. The robot is programmed using simple BASIC instructions. It makes an excellent foundation for many simple and advanced robot experiments. The kit includes all the hardware, structural components, Hitec servos, First Step Micro kit, software, and an illustrated assembly manual. The Lynxmotion Hexapod Walker is a lot of fun to build and even more fun to operate.

We have many more cool robots, check out our web page or ask for our free catalog!

Lynxmotion, Inc.

104 Partridge Road
Pekin, IL 61554-1403
www.lynxmotion.com



Tel: 309-382-1816
Fax: 309-382-1254
sales@lynxmotion.com
tech@lynxmotion.com

PIC C COMPILER

• Integrated software development environment including an editor with interactive error detection/correction.

• Access to all PIC hardware features from C.

• Libraries for RS232 serial I/O and precision delays.

• Efficient function implementation allows calls trees deeper than the hardware stack.

• Special built-in features such as bit variables optimized to take advantage of unique hardware capabilities.

• Functions that call one another frequently are grouped together in the same page and calls across pages are handled automatically by the tool transparent to the user.

• Assembly code may be inserted anywhere in the source and may reference C variables.

• Constants (including strings and arrays) are saved in program memory.

• Hex file output format is selectable to be readable by most programmers and simulators.

• PIC has interrupt, A/D and EEPROM built-in functions.

• Complete example program with RS-232 I/O:

```
#include <PIC16C56.h>
#define xt_xtcxt
#define DelayClock=20000000
#define RS232 Baud=9600,Xmit=pin_1,RCV=pin_2

main () {
    printf("Press any key to begin\n");
    goto();
    printf("1 kHz signal activated\n");
    while (TRUE)
        if (input_high(pin_8))
            delay_us(500);
        output_low(pin_8);
        delay_us(500);
    }
}
```

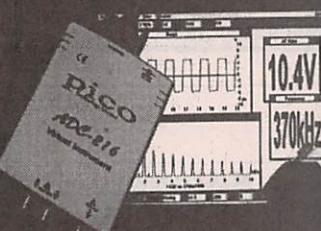
PCB Compiler \$99 (all 5x chips)

PCM Compiler \$99 (64,71,74,84 chips)

PCW Professional Package \$350
 (includes PCB & PCM in Windows IDE)

Custom Computer Services Inc
 PO Box 2452 Brookfield WI 53008
 <http://www.ccsinfo.com>
 email: ccs@ccsinfo.com
 Phone: 414.797.0455 ext. 35
 Fax: 414.797.0459

Turn your PC into a 16-bit Storage Scope spectrum analyzer, and digital multimeter!



ADC216 turns your PC or laptop into a sophisticated storage scope AND spectrum analyzer AND multimeter. Display on large screen! Print in color! 100MS/s 8-bit, 1.2MS/s 12-bit or 333KS/s 16-bit versions. Great for test depts, schools. Input to Excel, LabView/NT drivers. Get very high precision without high cost!

oszifox

handheld 20MS/s Storage Scope

oszifox is a sophisticated digital storage scope packed into a handy, slim penlike housing. Despite its small size, oszifox can perform like a service scope with a 20MS/s sampling rate so signals in microprocessor or audio circuits can be measured easily. A built-in backlit LCD shows the waveforms but the recorded signals can also be sent to a PC via a serial interface. Runs from 9V battery or external source. Auto, internal and external triggers. AC/DC voltmeter function too. Only \$129!

also

RS232-422/485 converters, self-powered, opto-isolated I2C adapter boards for PC communication with I2C bus mini dataloggers for events, voltages, pressures, etc. Enviromon temperature and environment netwk logger thermocouple and thermistor adapters for PC ports. BASIC-programmable BASIC-TIGER controller modules PCI framegrabbers - switch between 2 inputs locked! lowcost A/D adapters turn your PC into a display scope

PC
PLACE

Don't lose sight
of Glaucoma.



Saelig Company
www.saelig.com saelig@aol.com
716-425-3753 • 716-425-3835 (fax)

1-888-7SAELIG

2539 W. 237th Street, Bldg. F, Torrance, CA 90505
 Order desk only: USA: (800) 872-8878 CA: (800) 223-9977
 L.A. & Technical Info: (310) 784-5488 Fax: (310) 784-7590
 OEM INQUIRIES WELCOME

TIMELINE INC.

Over 13 years and 31,000 customers and still growing

Minimum Order: \$20.00. Minimum shipping and handling charge \$5.00. We accept cashiers checks, MC or VISA. No personal checks or COD's. CA residents add 8.25% sales tax. We are not responsible for typographical errors. All merchandise subject to prior sale. Phone orders welcome. Foreign orders require special handling. Prices subject to change without notice. 20% restocking fee for returned orders.

LIQUID CRYSTAL DISPLAYS

240x64 dot LCD with built-in controller.
 AND 4021ST-EO. Unit is EL back-lit. \$59.00 or 2 for \$109.00 or
 OPTREX. DMF5005 (non back-lit) \$49.00 or 2 for \$89.00
 20 character x 8 line 7.6L x 2.2H The built-in controller allows you to do text and graphics.

Alphanumeric—parallel interface

16x1	\$7.00	20x2	\$10.00	32x2	\$8.00
16x1 (lg. char.)	\$10.00	20x4	\$15.00	40x1	\$8.00
16x2	\$7.00	20x4 (lg. char.)	\$10.00	40x2	2 for \$20.00
16x2 (lg. char.)	\$10.00	24x2	\$10.00	40x4	\$20.00
16x4	\$15.00	32x4	\$10.00	42x2	\$5.00

5V power required • Built-in C-MOS LCD driver & controller • Easy "microprocessor" interface • 98 ASCII character generator • Certain models are back-lit, call for more info.

Graphics and alphanumeric—serial interface

size	Mfr.	price	size	Mfr.	price
640x480 (backlit)	Epson	\$25.00	480x128	Hitachi	\$10.00
640x400 (backlit)	Panasonic	\$20.00	256x128	Epson	\$20.00
640x200	Toshiba	\$15.00	240x128 (backlit)	Optrex	\$20.00
480x128 (backlit)	ALPS	\$10.00	240x64	Epson	\$15.00
			160x128	Optrex	\$15.00

6" VGA LCD 640X480, Sanyo LMDK55-22 \$25.00

MONITORS

Non-Enclosed TTL

Comes with pinout, 12V at 1.4 Amp input • Horizontal Frequency 15KHz • Ability to do 40 and 80 column.
 5 inch Amber \$25.00 • 7 inch Amber \$25.00
 9 inch Amber or Green \$25.00

5" COLOR MONITOR \$39.00

- Flat Faceplate • 320 x 200 Dot Resolution • CGA & Hercules Compatible
- 12 VDC Operation • 15.75 KHz Horiz. Freq. • 60 Hz Vert. Sync. Freq.
- Open Frame Construction • Standard Interface Connector • Degaussing Coil included • Mfr. Samtron

2 for \$69.00

9" COLOR SVGA MONITOR \$179.00 Fully Enclosed – Tilt and swivel type.

POS & BAR CODE

MAGNETIC CARD READER \$25.00

Includes: • 20 character dot matrix display with full alpha-numeric capability • Keypad with full alpha-numeric entry • Separate 7.5 VDC/0.5 Amp power supply • Standard telephone interface extension cord • Lithium battery and flat-tone speaker.

HP bar code wand (HIBCS 2300) \$19.00

DATA ACQUISITION & CONTROL

AFFORDABLE PLUG-IN BOARDS FOR PC's ISA BUS

ANA100 Analog I/O \$ 99



- 8 Channel 8-Bit
- 0 to 5 Volt Input
- 14 TTL I/O lines
- Analog Output
- 400KHz Sampling

DIG100 Digital I/O \$ 39



- 82C55 PPI
- 24 or 48 TTL I/O
- Lines option
- Selectable Base Address

ANA150 Analog/Counter... \$ 89



- 8 Channel 8-Bit
- 0 to 5 Volt Input
- 3 16-Bit Counters
- 400KHz Sampling

DIG200 Counter I/O \$ 79



- 3 16-Bit Counters
- 8 TTL Input lines
- 8 TTL Output lines
- Selectable Clock Frequency Input

ANA200 Analog I/O \$ 79



- 1 Channel 12-Bit
- 0 to 5 Volt Input
- optional bi-polar
- 100KHz / 300KHz Sampling rate
- 24 TTL I/O lines

ANA201 Analog \$ 119



- 8 Channel 12-Bit
- x1, x5, x10, x50 Programmable Channel gain
- 100KHz Sampling rate

On-Line Product Catalog at Our Web Site

<http://www.Bsof.com>

E-Mail: Sales@Bsof.com

BSOFT Software, Inc.

444 COLTON ROAD * COLUMBUS, OH 43207
 PHONE 614-491-0832 * FAX 614-497-9971

HACKER CORNER

EMBEDDED 486 COMPUTER \$99.00

Complete enhanced Intel 486SX-33 based computer in ultra small (9.7/8L x 6.5/8W x 3.1/8H) case. Ideal for embedded operations or as a second computer. Features include: • One 16 bit ISA slot • 3 serial ports plus dedicated printer port • Parallel optical coupled adapter port • Built in IBM PC/AT keyboard port • On board VGA video and port • Uses standard SIMM up to 32 MB • BIOS is PC/AT compatible

Unit has a backup Ni-Cd battery system in case of power failure (5 min. backup time) and lockable front cover to prevent floppy drive access. Mounting / interface provisions for standard 3.5" laptop floppy and 2.5 inch hard drives. Comes with very comprehensive manual.

SONY Miniature Color LCD Display (LCX005BKB) \$29.00

• 1.4 CM (0.55 inch) Diagonal Full Color Display • Built In Horizontal and Vertical Drivers • Delta Dot Pattern for High Picture Quality - 537 dots (H) x 222 dots (V) • Compatible with NTSC & PAL Format and Sync Input • 12 VDC Operation with -I to +17 V RGB Signal and Drive Input Voltage • Excellent Display for Virtual Reality Projects, Viewfinders, and Miniature Test Equipment Displays • Pin Outs and Specification Included • Unit Requires Clock, Synchronization and Video

CELL SITE TRANSCEIVER \$49.00 2 for \$89.00

These transceivers were designed for operation in an AMPS (Advanced Mobile Phone Service) cell site. The 20 MHz bandwidth of the transceiver allows it to operate on all 666 channels allocated. The transmit channels are 870.030-889.980 MHz with the receive channels 45 MHz below those frequencies. A digital synthesizer is utilized to generate the selected frequency. Each unit contains two independent receivers to demodulate voice and data with a Receive Signal Strength Indicator (RSSI) circuit to select the one with the best signal strength. The transmitter provides a 1.5 watt modulated signal to drive an external power amplifier, channel selection is accomplished with a 10 bit binary input via a connector on the back panel. Other interface requirements for operation are 26 VDC (unregulated) and an 18.900 MHz reference frequency for the digital synthesizer. The units contain independent boards for receivers, exciter, synthesizer, tunable front end, and interface assembly (which includes power supplies and voltage-controlled oscillator). Service manual, schematics and circuit descriptions included.

Enclosed Spread Spectrum RF Modem \$99.00

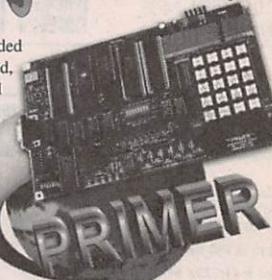
The ProLink Radio Module is a small communication device which replaces cables between RS-232 devices with wireless RF (Radio Frequency) technology. Attaching a pair of ProLinks to any two devices with three wire asynchronous RS-232 ports allows wireless data transmission at rates up to 19.2 Kbaud (full duplex) over a range of 500 - 800 feet. Modules use 900 MHz spread spectrum radio for communication which does not require an FCC site license. A variety of configuration information (radio channel, baud rate, serial port configuration, etc.) can be programmed into module's non-volatile memory by host PC to provide compatibility and avoid overlapping systems. Configuration changes are supported by menu driven, on-board software. Commonly used Terminal Emulation software and transfer protocols can be used for configuring modules and transferring data between computers. ProLinks require only 6-9 VDC (350 mA), RS-232 (9 pin sub - D) interface, and small (~ 4") whip antenna for operation. Unit size is 4.0" x 6.5" x 0.75". Installation schematics and application details available. These are 100 Mw power.

COLOR CCD CAMERA \$89.00

Small fully enclosed color CCD camera ideally suited for video conference and mobile operations. No separate power supply or batteries needed - single 5 VDC power requirement can be obtained from PC keyboard interface or directly from the computer using the included adapter plugs. Standard NTSC composite output from 1/4" color CCD sensor with 250,000 pixels and automatic white balance.

World Passing You By?

Are you interested in Microprocessors & Embedded Control Systems? If not you should be! Look around, just about everything these days has an embedded microprocessor in it. TVs, cars, radios, traffic lights & even toys have embedded computers controlling their actions. The PRIMER Trainer is the tool that can not only teach you how these devices operate but give you the opportunity to program these types of systems yourself. Examples & exercises in the Self Instruction manual take you from writing simple programs to controlling motors. Start out in Machine language, then move on to Assembler, & then continue on with optional C, Basic, or Forth Compilers. So don't be left behind; this is information you need to know!



- Measuring Temperature
- Using a Photocell to Detect Light Levels
- Making a Waveform Generator
- Constructing a Capacitance Meter
- Motor Speed Control Using Back EMF
- Interfacing and Controlling Stepper Motors
- Scanning Keypads and Writing to LCD/LED Displays
- Bus Interfacing an 8255 PPI
- Using the PRIMER as an EPROM Programmer
- DTMF Autodialer & Remote Controller (New!)

The PRIMER is only \$119.95 in kit form. The PRIMER Assembled & Tested is \$169.95. This trainer can be used stand alone via the keypad and display or connected to a PC with the optional upgrade (\$49.95). The upgrade includes: an RS232 serial port & cable, 32K of battery backed RAM, & Assembler/Terminal software. Please add \$5.00 for shipping within the U.S. Picture shown with upgrade option and optional heavy-duty keypad (\$29.95) installed. Satisfaction guaranteed.

EMAC, inc.
 11 EMAC WAY, CARBONDALE, IL 62901
 618-529-4525 Fax 457-0110 BBS 529-5708
 World Wide Web: <http://www.emacinc.com>

1985 - 1998

OVER
 12
 YEARS
 OF SERVICE

Dalbani

www.dalbani.com

Computer Cases

Lexon®

\$45.00

Nickel Chassis
with built in
250 power
supplies
7 ATX Slots
7 AT Slots

FCC Approved

Item # 95-4025



RCA

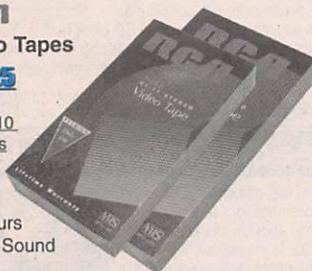
Video Tapes

\$1.25

Min. 10
pieces

6 Hours
Hi-Fi Sound

Item # 50-1005

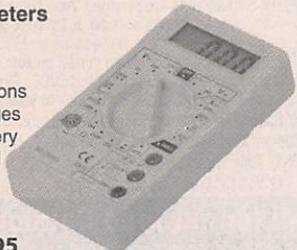


Multimeters

\$7.95

6 Functions
19 Ranges
9V Battery
Included

Item #
50-2895



Amplifiers

\$19.90



120 Watt
Separate
Bass/Treble Switch

Item # 89-3470

Soldering Station

\$34.95

Variable Power
Control (5-40W)
Interchangeable Tip
& Heating Element



Item # 51-1505

Weller

MAGNAVOX

Remote Control

\$5.95

Min. 5 pieces
Controls
3 Units
TV, VCR,
Cable Box



Item # 82-1380

GEMINI II

Power Strip

\$3.45

25 Joules
6 Outlets



Item # 40-1755

SONY
PlayStation

\$24.95

Minimum
3 pieces

Laser Pickup

Original Sony# KSM-440ACM

Item # 46-4720



Clearance

\$24.95

Aluminum frame
Tool Case

Item# 50-1890 Black



CALL TOLL FREE

1-800-325-2264

SPECIAL SHIPPING RATE

e-mail: savings@dalbani.com

\$20.00
Minimum Order
not including shipping & handling



3.95 plus shipping
and handling

Up to 5 lbs anywhere in the U.S.A.
Excluding Alaska, Hawaii & Puerto Rico.

World's Smallest TV Transmitters

We call them the 'Cubes'.... Perfect video transmission from a transmitter you can hide under



a quarter and only as thick as a stack of four pennies - that's a nickel in the picture! Transmits color or B&W with fantastic quality - almost like a direct wired connection to any TV tuned to cable channel 59. Crystal controlled for no frequency drift with performance that equals law enforcement models that cost hundreds more! Basic 20 mW model transmits up to 300' while the high power 100 mW unit goes up to 1/4 mile. Audio units include sound using a sensitive built-in mike that will hear a whisper 15 feet away! Units run on 9 volts and hook-up to most any CCD camera. Any of our cameras have been tested to mate perfectly with our Cubes and work great. Fully assembled - just hook-up power and you're on the air!

C-2000, Basic Video Transmitter Cube.....\$89.95
C-3000, Basic Video & Audio Transmitter Cube.....\$149.95
C-2001, High Power Video Transmitter Cube.....\$179.95
C-3001, High Power Video & Audio Transmitter Cube...\$229.95

CCD Video Cameras

Top quality Japanese Class 'A' CCD array, over 440 line resolution, not the off-spec arrays that are found on many other cameras. Don't be fooled by the cheap CMOS single chip cameras which have 1/2 the resolution, 1/4 the light sensitivity and draw over twice the current! The black & white models are also super IR (Infrared) sensitive. Add our invisible to the eye, IR-1 illuminator kit to see in the dark! Color cameras have Auto gain, white balance, Back Light Compensation and DSPI! Available with Wide-angle (80°) or super slim Pin-hole style lens. Run on 9 VDC, standard 1 volt p-p video. Use our transmitters for wireless transmission to TV set, or add our IB-1 Interface board kit for audio sound pick-up and super easy direct wire hook-up to any Video monitor, VCR or TV with AV input. Fully assembled, with pre-wired connector.

CCDWA-2, B&W CCD Camera, wide-angle lens.....\$69.95
CCDPH-2, B&W CCD Camera, slim fit pin-hole lens.....\$69.95
CCDCC-1, Color CCD Camera, wide-angle lens.....\$129.95
IR-1, IR Illuminator Kit for B&W cameras.....\$24.95
IB-1, Interface Board Kit.....\$14.95

Mini Radio Receivers

Imagine the fun of tuning into aircraft a hundred miles away, the local police/fire department, ham operators, or how about Radio Moscow or the BBC in London? Now imagine doing this on a little radio you built yourself - in just an evening! These popular little

receivers are the nuts for catching all the action on the local ham, aircraft, standard FM broadcast radio, shortwave or WWV National Time Standard radio bands. Pick the receiver of your choice, each easy to build, sensitive receiver has plenty of crystal clear audio to drive any speaker or earphone. Easy one evening assembly, run on 9 volt battery, all have squelch except for shortwave and FM broadcast which has handy SCA output. Add our snazzy matching case and knob set for that smart finished look.

AR-1, Airband 108-136 MHz Kit.....\$29.95
HFRC-1, WWV 10 MHz (crystal controlled) Kit.....\$34.95
FR-1, FM Broadcast Band 88-108 MHz Kit.....\$24.95
FR-6, 6 Meter FM Ham Band Kit.....\$34.95
FR-10, 10 Meter FM Ham Band Kit.....\$34.95
FR-146, 2 Meter FM Ham Band Kit.....\$34.95
FR-220, 220 MHz FM Ham Band Kit.....\$34.95
SR-1, Shortwave 4-11 MHz Band Kit.....\$29.95
Matching Case Set (specify for which kit).....\$14.95

Tiny FM Transmitters



Gosh, these babies are tiny - that's a quarter in the picture! Choose the unit that's best for you. FM-5 is the smallest tunable FM transmitter in the world, picks up a whisper 10' away and transmits up to 300'. Runs on tiny included watch battery, uses SMT parts. FM-4 is larger,

more powerful, runs on 5-12 volts, goes up to a mile. FM-4.5 operates in standard FM band 88-108 MHz. FM-6 is crystal controlled in 2 meter ham band, 146.535 MHz, easily picked up on scanner or 2 meter rig, runs on 2 included watch batteries. SMT (surface mount) kits include extra parts in case you sneeze & loose a part!

FM-4MC, High Power FM Transmitter Kit.....\$17.95
FM-5, World's Smallest FM Transmitter Kit.....\$19.95
FM-6, Crystal Controlled 2M FM Transmitter Kit.....\$39.95
FM-6, Fully Wired & Tested 2M FM Transmitter.....\$69.95

Super Pro FM Stereo Transmitter

Professional synthesized FM Stereo station in easy to use, handsome cabinet. Most radio stations require a whole equipment rack to hold all the features we've packed into the FM-100. Set freq with Up/Down buttons, big LED display. Input low pass filter gives great sound (no more squeals or swishing from cheap CD inputs!) Limiters for max 'punch' in audio - without over mod, LED meters to easily set audio levels, built-in mixer with mike, line level inputs. Churches, drive-ins, schools, colleges find the FM-100 the answer to their transmitting needs, you will too. Great features, great price! Kit includes cabinet, whip antenna, 120 VAC supply. We also offer a high power export version of the FM-100 that's fully assembled with one watt of RF power, for miles of program coverage. The export version can only be shipped outside the USA, or within the US if accompanied by a signed statement that the unit will be exported.

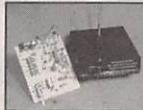
FM-100, Pro FM Stereo Transmitter Kit.....\$249.95
FM-100WT, Fully Wired High Power FM-100.....\$399.95



FM Stereo Radio Transmitters

No drift, microprocessor synthesized! Excellent audio quality, connect to CD player, tape deck or mike mixer and you're on-the-air. Strapable for high or low power! Runs on 12 VDC or 120 VAC. Kit includes case, whip antenna, 120 VAC power adapter - easy one evening assembly.

FM-25, Synthesized FM Stereo Transmitter Kit.....\$129.95



Lower cost alternative to our high performance transmitters. Great value, tunable over FM band, plenty of power and manual goes into great detail about antennas, range and FCC rules. Handy kit for sending music thru house and yard, ideal for school projects too - you'll be amazed at the exceptional audio quality! Runs on 9V battery or power from 5 to 15 VDC. Add our matching case and whip antenna set for a nice 'pro' look.

FM-10A, Tunable FM Stereo Transmitter Kit.....\$34.95
CFM, Matching Case and Antenna Set.....\$14.95
FMAC, 12 Volt DC Wall Plug Adapter.....\$9.95

RF Power Booster

Add muscle to your signal, boost power up to 1 watt over a freq range of 100 KHz to over 1000 MHz! Use as a lab amp for signal generators, plus many foreign users employ the LPA-1 to boost the power of their FM transmitters, providing radio service through an entire town. Runs on 12 VDC. For a neat finished look, add the nice matching case set.

LPA-1, Power Booster Amplifier Kit.....\$39.95
CLPA, Matching Case Set for LPA-1 Kit.....\$14.95
LPA-1WT, Fully Wired LPA-1 with Case.....\$99.95



FM Station Broadcast Antenna

For maximum performance, a good antenna is needed. Properly tuned and matched antenna is fully PVC enclosed for weather protection and rugged use. Vertical or horizontal mounting, 'F' style connector, 5' long.

TM-100, Tru-Match FM Station Antenna Kit.....\$39.95



AM Radio Transmitter

Operates in standard AM broadcast band, set to clear channel in your



area. AM-25 'pro' version is synthesized for stable, no-drift frequency and is settable for high power output where regulations allow, typical range of 1-2 miles. Entry-level AM-1 has tunable transmit oscillator, runs FCC maximum 100 mw power, expected range 1/4 mile. Both accept line-level inputs from tape decks, CD players or mike mixers, run on 12 volts DC. Pro AM-25 includes AC power adapter, matching case and bottom loaded whip antenna. Entry-level AM-1 has an available matching case and knob set for a finished, professional look. High level modulation for low distortion.

AM-25, Professional AM Transmitter Kit.....\$129.95
AM-1, Entry level AM Radio Transmitter Kit.....\$29.95
CAM, Matching Case Set for AM-1.....\$14.95



RAMSEY

Binocular Special

Wow, did we nab a deal on these first rate binoculars! Absolutely identical to a famous big name brand here in Rochester, NY - but without 'their' name. Well made with fully coated optics, super nice rubber armored housing over hi-alloy aluminum, includes lens cleaner cloth, neck lanyard and carry case. 4 styles: roof prism 10x25 (10 power, 25 mm), 10x25 high performance roof prism ruby coated objective lens model for demanding use in bright sun, 10x25 high-end BAK-4 lens porro prism ruby coat with Tac-Grip housing, and Ultra-View 10x50 porro prism ruby coats. First quality, yet at a close-out price on the exact same units as the 'Trademarked' units - but at half price!



BNO-M, 8x21 Mini Monocular.....\$14.95
BNO-1, 10x25 Roof Prism Binoculars.....\$24.95
BNO-1EX, 10x25 Ruby Coated Porro Prism.....\$29.95
BNO-2, 10x25 TacGrip Ruby Coat Porro Prism.....\$59.95
BNO-6, 10x50 Ultra-View Ruby Coat Porro Prism.....\$69.95

World's Smallest FM Radios

Everyone who sees one of these babies says they just gotta have one! Super cute tiny FM radios have automatic scan/search tuning, comfortable ear bud earphones and we even include the battery. The pager style unit looks like a shrunken pager and even has an LCD clock built-in. You will be amazed at the crystal clear amazing sound! That's a quarter in the picture for size comparison - pretty tiny, huh?



MFMT-1, World's Smallest FM Radio.....\$11.95
PFMR-1, Pager Style LCD Clock & FM Radio.....\$12.95

Speech Descrambler

Decode all that gibberish! This is the popular descrambler / scrambler that you've read about in all the Scanner and Electronic magazines. Speech inversion technology is used, which is compatible with most cordless phones and many police department systems, hook it up to your scanner speaker terminals and you're in business. Easily configured for any use: mike, line level and speaker output/inputs are provided. Also communicate in total privacy over telephone or radio, full duplex operation - scramble and unscramble at the same time. Easy to build, all complex circuitry contained in new custom ASIC chip for clear, clean audio. Runs on 9 to 15VDC. Our matching case set adds a professional look to your kit.



SS-70A, Speech Descrambler/Scrambler Kit.....\$39.95
CSS, Custom Matching Case and Knob Set.....\$14.95
SS-70AWT, Fully Wired SS-70A with Case.....\$79.95
AC12-5, 12 Volt DC Wall Plug Adapter.....\$9.95

Call for our Free Catalog!

See our complete catalog and order on-line with our secure server at:

www.ramseyelectronics.com

RAMSEY ELECTRONICS, INC.

793 Canning Parkway Victor, NY 14564

Order Toll-free: 800-446-2295

Sorry, no tech info, or order status at this number

For Technical Info, Order Status Call Factory direct: 716-924-4560



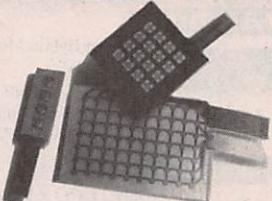
ORDERING INFO: Satisfaction Guaranteed. Examine for 10 days, if not pleased, return in original form for refund. Add \$6.95 for shipping, handling and insurance. Orders under \$20, add \$3.00. NY residents add 7% sales tax. Sorry, no CODs. Foreign orders, add 20% for surface mail or use credit card and specify shipping method.

ABC ELECTRONICS 315 7TH AVE N. MPLS. MN. 55401
 (612)332-2378 FAX (612)332-8481 E-MAIL SURP1@VISI.COM
 WE BUY TEST EQUIPMENT AND COMPONENTS.

VISIT US ON THE WEB AT WWW.ABCTEST.COM

HP 5401A 100MHZ DIGITIZING SCOPE	\$1300.00	HP 4935A TRANS. IMPAIRMENT TEST SET	\$900.00
HP 54201D 300MHZ DIGITIZING SCOPE	\$1000.00	HP 5006A SIGNATURE ANALYZER	\$150.00
HP 54201A 300MHZ DIGITIZING SCOPE	\$1000.00	HP 86602B 1MHZ-1300MHZ RF PLUG	\$400.00
HP 54200A 50MHZ SCOPE/WAVEFORM ANALYZER	\$700.00	EIP 575 MICROWAVE COUNTER	\$1500.00
HP 3312A 13MHZ FUNCTION GENERATOR	\$250.00	FLUKE 95 50MHZ SCOPEMETER	\$550.00
HP 5370A 100MHZ U.T.I. COUNTER	\$400.00	LECROY 7200 400MHZ O-SCOPE	\$1000.00
HP 3586C LEVEL METER	\$750.00	TEK 475 200MHZ O-SCOPE	\$500.00
HP 436A POWER METER W/O SENSOR/CABLE	\$500.00	TEK 465 100MHZ O-SCOPE	\$400.00
HP 8350B SWEEP OSCILLATOR MAINFRAME	\$2000.00	TEK 496P 1KHZ-1.8GHZ SPEC ANALYZER	\$3500.00
HP 3137A 3.5DIGIT SYSTEM VOLT METER	\$250.00	TEK 1240 LOGIC ANALYZER	\$750.00
HP 3455A DIGITAL MULTIMETER	\$250.00	TEK TDS320 100MHZ DIGITAL O-SCOPE	\$1400.00
HP 3456A DIGITAL MULTIMETER	\$400.00	TEK 11401A 500MHZ PROG.O-SCOPE FRAME	\$750.00
HP 3366C SYNTHESIZER/LEVEL GENERATOR	\$800.00	TEK 7854 400MHZ OSCILLOSCOPE FRAME	\$500.00
HP 3325A SYNTHESIZER/FUNCTION GENERATOR	\$1000.00	TEK 7904 400MHZ OSCILLOSCOPE FRAME	\$250.00
HP 5335A 200MHZ COUNTER	\$600.00	TEK 7A26 200MHZ VERTICAL PLUG	\$75.00
HP 8165A PROGRAMMABLE SIGNAL SOURCE	\$1100.00	TEK 7A24 400MHZ VERTICAL PLUG	\$150.00
HP 8558B/181 100K-1500MHZ SPECTRUM ANALYZER	\$1000.00	TEK 7B80 400MHZ TIME BASE	\$75.00
HP 8559B/183 10MHZ-21GHZ SPECTRUM ANALYZER	\$3000.00	TEK 7B92A 500MHZ DUAL TIME BASE	\$125.00
HP 1740A 100MHZ OSCILLOSCOPE	\$250.00	TEK 7S12 SAMPLING PLUG	\$250.00
HP 6034A 60VDC-10A POWER SUPPLY	\$750.00	TEK 7L14 10KHZ-1.8GHZ SPEC. ANALYZER	\$1000.00
HP 6269B 40VDC-50A POWER SUPPLY	\$800.00	TEK AM503 CURRENT PROBE AMPLIFIER	\$250.00
HP 6553A 40VDC-12.5A POWER SUPPLY OPT.J01	\$1200.00	WAVETEK 145 20MHZ PULSE/FUNCTION GEN.	\$400.00
HP 6632A 20VDC-5A POWER SUPPLY	\$500.00	WAVETEK 182A 4MHZ FUNCTION GEN.	\$150.00
HP 6643A 45VDC-4.3A POWER SUPPLY OPT.J03	\$750.00	WAVETEK 955 7.5-12.4GHZ MICROSOURCE	\$1100.00

MEMBRANE SWITCHES



Stock Layouts!

Eliminates tooling cost...

****From 2 to 128 keys****

Industrial/Commercial/Prototyping

Popular types are available as complete kits, with bezel, connector & overlay!

**4 key DSK-4 kit \$9.60
 12 key DSK-12 kit \$13.87
 many more layouts...**

Optional Stainless Steel "Clickdomes".

Sil-Walker

(805) 491-0654

FAX (805) 491-2212

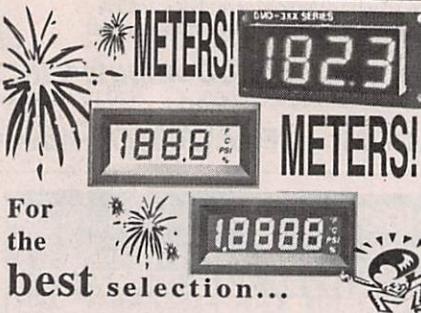
P.O. Box 3220

Camarillo, CA 93011-3220

silwkr@vcnet.com

www.vcnet.com/silwkr/

MASTERCARD/VISA



For the best selection...

KNS
Instruments

Call for a FREE catalogue or

Visit us on the web: www.knsinstruments.com

800-356-4920

Digital Panel Meters!!

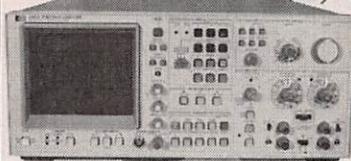
LCDs • LEDs • 3 1/2 digits
 • 4 1/2 digits • loop powered • adjustable voltage
 input • bezel mount • surface mount • miniatures •
 big digits • black • red • amber • green • negative
 backlighting • positive backlighting • RF resistant •
 EMI resistant • displayed engineering units • snap-in •

We also have Kroy tape
 and shrink tube labeling
 systems and supplies!

MasterCard
 VISA

PO Box 10158
 Bedford, NH 03110-0158
 Fax 800-356-1250

Hewlett Packard 3582A \$2,450



Real-Time Spectrum Analyzer,
 Dual Channel 0.02Hz to 25.599Khz

\$3,900

Tektronix 2465

DC-300Mhz Bandwidth

4 Channel

1nS Rise Time

On-Screen Readout

Auto Setup

Save and Recall Setups

\$1,995

Included Accessories:

2 probes P6131 operators manual,
 pouch, and cover.

Fluke 5100B/03/05 Calibrator

The 5100B is a low cost multimeter calibrator with six functions DC volts, AC volts, DC current, AC current, and Ohms. This calibrator can calibrate up to 4/2 digit meters with option 03 the AC frequency range is 50HZ to 10Mhz and with option 05 the IEEE-488 interface.

Boonton RF Power Meter with Sensor

4220-S/3 with 51100 Sensor and Cable

Digital LED Display in 3 modes (dBm, dBr, Watts)

Stores Calibration Data on up to 4 Sensors

10MHz to 18GHz Thermocouple Sensor

-30 to +20 dBm (1uW to 100mW) **\$1,250**

Hewlett Packard 8672A

2-18Ghz Synthesized Signal Generator

External AM,FM, and Pulse Modulation

HPIB Programmable **\$4,995**

2-18 GHz in 4 bands (18.6 GHz overrange)

Digital Frequency Display, up to 1 kHz resolution

Levelled output -120 to +8 dBm

External AM and FM with analog metering



\$2,495

Fluke 6061A

Programmable
 Synthesized
 Signal Generator

10kHz to 1050 MHz,

10 Hz resolution

-127 to +13dBm,

.1 dBm resolution

Internal/External AM and FM

Tektronix Oscilloscope "Cal-Pak"

Industry Standard in TM503 Package

PG506 Provides signals for amplitude

TG501 Provides time marks from 5 Seconds to 1 nanosecond intervals

FG503 Provides levelled sine wave from 50kHz to >250 MHz

with cal & certs.

\$2,595

www.web-tronics.com

Fantastic DMM Offer!

Don't let this price fool you. This meter is a digital multimeter designed for engineers and hobbyists. Equipped with 5 functions and 19 ranges. Each test position is quickly and easily selected with a simple turn of the FUNCTION/ RANGE selector rotary switch. Rubber Boot Included!

Display: 3-1/2 Digit LCD, 21mm Figure Height with Automatic Polarity

Overrange Indication: 3 Least Significant Digits Blank

Temperature Ranges: -5°C to 75°C

Power: 9V Alkaline or Carbon-Zinc Battery (NEDA 1604)

Low Battery Indication: BAT on Left of LCD Display

Dimensions: 188mm(L) x 87mm(W) x 33mm thick

Net Weight: 400g

Get All the Specs From Our Web Site



ONLY
\$19

www.web-tronics.com

7 1/2" Pro Modular Crimping Tool Kit

ONLY
\$64.95

Includes:

- Heavy Duty Ratchet
- Crimp Tool
- 5 Die Sets!

Details on our Web Site

#HT-330K

True RMS DMM

ONLY
\$69

• Full Sized, 4 1/2 Digit
Frequency Range to 20 KHz

• Capacitance Ranges from

2000 pF to 20 uF

• HFE, Audible Continuity

20A max 1000VDC/20A

max & 700VAC max

• Selectable Data Hold

Function



CSI-980
DMM

www.web-tronics.com

Don't forget
the dash

Auto-Temp Solder Station with Ceramic Element

ONLY
\$39

• With Ceramic Heating Element for More Accurate Temp Adjustment

• 3 Conductor Grounded Power Cord

• 250°C-480°C (470°F-900°F)

• Fast Heating Feature

Extra Tip Options Available. See Web!

For More Info See www.web-tronics.com

CCD B&W Board Cameras

- ASIC CCD Area Image Sensor
- Extremely Low Power Consumption
- 0.5 Lux Min Illumination
- Built-In Electronic Auto Iris for Auto Light Compensation

Detailed Specs on the Web

VM1030PA
Pinhole lens with audio, 30mmx30mmx25mm, 12V, 430 horz and vert TV lines

\$59.00 \$49.00
5 or more

Infra-Red!

VMCB21
44mmx38.5mmx28mm with 6 infra-red LEDs, 12V, 380 TV lines

ON SALE
\$59.00 any qty.

Reg. \$69.00

VM1035A
42mmx42mmx25mm Standard lens with audio, 12V, 430 horz & vert TV lines with back light compensation

\$77.00 \$68.00
5 or more

VM1030A
30mmx30mmx26mm Standard lens with audio, 12V, 430 horz & vert TV lines

\$59.00 \$49.00
5 or more

VM1036A
32mmx32mmx25mm Standard lens with audio, 12V, 430 horz & vert TV lines, reverse mirror image feature

\$69.00 \$63.00
5 or more

VM3011-A
45mmx40mmx24mm Standard lens with audio, single board

\$147.00 \$139.00
5 or more

VM3010-A
33mmx33mmx32mm Standard lens with audio

\$144.00 \$129.00
5 or more

www.web-tronics.com

Removable Hard Drive Rack

For IDE/Ultra DMA Hard Drives

We Sold Over 14,000 in 1998!

ONLY
\$14.95

RH-10C-IDE

13.5mmx10.5mmx4.5mm

Weight: 10g

Color: Black

Material: ABS

Mounting: 4x M3x5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

Mounting Hole: 13.5mm

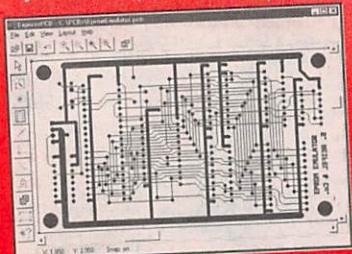
Mounting Hole: 4.5mm

Mounting Hole: 10.5mm

PCB LAYOUT

Software For Windows - FREE

- 1 Download our board layout software
- 2 Design your 2 sided plated-through PCB
- 3 Send us your layout over the Internet
- 4 In 2-3 business days, UPS delivers your boards, often under \$100



www.expresspcb.com

Printed Circuits in Minutes Direct From LaserPrint!

8 1/2" x 11"

* Or Photocopy

**Use standard
household iron
or P-n-P Press.

Press-n-Peel

Use Standard Copper Clad Board

20 Shts \$30/ 40 Shts \$50/ 100 Shts \$100

Visa/MC/PO/Ck/MO \$4 S&H

Techniks Inc.

P.O. Box 463

Ringoes NJ 08551

ph. 908.788.8249 fax 908.788.8837

<http://Chelsea.ios.com/~techniks>

Retail Dealer Inquiries Invited

1. LaserPrint*
2. Press On**
3. Peel Off
4. Etch

Serial Video Text Display Module

NEW BOB-II superimposes up to 308 characters on NTSC/PAL video or generates video. 30-pin SIMM design, fast RS-232 serial interface, easy to use for:

Video Inspection - NDT
Home Automation - MATV
Surveillance - CCTV - ATV
Remotely Piloted Vehicles
Gaming - Racing - Sports
Process/Experiment Monitor
Robotics - Electronic Signs

Very Low Cost ~ Really!

Complete Information at: www.decadenet.com

DECADE ENGINEERING

5504 ValView Dr. SE, Turner, OR 97392
Tel: 503.743.3194 ~ Fax: 503.743.2095

Only
\$29.95

The Hack & Crack Bible on CD-ROM

Includes all Software, Documentation, Plans, and PCB Layouts!

Unlock the secrets of:

- DSS & Smart Cards
- Programming & Schematics
- Cable Test Devices
- Sony Playstation
- Mod Chip/CD Backups/Emulation
- Backup Sega & SNES Console Cartridges
- Sega & SNES Emulation on your PC or Mac
- Warez - where to find them on the Internet
- Cellular Hack/Phreak/Mod
- And Much More!

PC & Mac Compatible CD-ROM

We accept

VISA • MasterCard • American Express

To order, call Worldwide @ 1-800-773-6698
21365 Randall Street • Farmington Hills, MI 48336
Visit us on the web at www.worldwide.com/hack

FRIENDLY LITTLE MICRO CONTROLLER

\$149
(single)



...packs a **MEAN** punch
a.k.a. "Steroid Stamp"

- 39 I/O + 8 A/D (10 bit)
- 128K SRAM + 128K Flash
- LCD/Keypad Interface
- Fast 16 bit Motorola CPU
- Affordable C Compiler
- Comprehensive s/w Library

Intec Automation Inc.

www.steroidmicros.com

v: 250-721-5150

fx: 250-721-4191

100 Mbit Networking

for Small Office/Home Office at 10 Mbit 4/12/99
pricing: Complete Kit for 2 machines, 5-port auto switching 100/10 Mbit D-Link hub, 2 100/10 Mbit cards with PCI interface, 2 x 25' CAT5 cabling (add \$0.25/ft for longer runs) **\$129**

 Avoid Ethernet Collisions, speed up your network, replace your hub with a switch!

Eight (8) 10/100 auto-negotiating non-blocking switch ports with full duplex capability for a combined 1.6 Gbit bandwidth **\$299**
1, 2, 4, 5, 12 and 16 port switches and switch/hub combinations with up to 27 ports available, please request information.

tech-specialities, Inc.

(800)864-5391, fax: (713)307-0315

email: sales@ts.nu, web: www.ts.nu

Ask for our Free Shipping option!

Catalog with detailed info on networking gear, illustrated, with technical tips free!

Auto Power Control
Collimated Laser
Compact Size
100,000 hr lifetime
No Electronics Required



Visible Laser Modules(635-670 nm)
TTL Modulated Laser Modules
Line Generator Laser Modules
Infrared Laser Modules(780-830 nm)

from
\$ 29 (US)

LASER POINTER



Focus Adjustable
Elegant Design
Solid Metal Body

\$19.95 (US)

Pen Style Laser Pointer (1500 ft visibility)
Key Chain Laser Pointer (1500 ft visibility)
Available in silver and, black finish.

Ask for free catalog

World Star Tech. Tel:(416)204 6298 Fax:(416)596 7819

<http://www.worldstartech.com> e-mail: info@worldstartech.com

ELECTRONIC COMPONENTS

J-Tron, an electronic components distributor serving manufacturers and hobbyists.

- Capacitors
- Resistors
- Test Meters
- Kits
- NTE Devices

Web www.j-tron.com

Visit our website & enter our contest for a test meter.

CALL TODAY!
888-595-8766

24 Hour Fax:
973-478-8708

Direct from Manufacturer We will beat any competitor's price

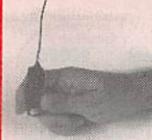
World's Smallest Wireless Video Camera!

- Transmits video up to 1000 ft.
- Runs on 9V battery for 12 hrs.
- Can be built into just about anything (beeper, clock, etc.)

We also carry:

- Color micro video cameras
- B&W micro video cameras
- Hidden cameras
- Custom video systems
- Countersurveillance
- More

World's smallest
plug & play system
about 1" x 1"



Looking
for
Distributors

Call for a free catalog (305) 667-4545

SECURETEK Fax (305) 667-1744

7175 SW 47 St. #205 • Miami, FL 33155

PIC Programmer Kits

Our PIC Programmer kits of parts attach to the parallel port of a PC and contain the following: PCB, parts and instructions. Uses a straight through (25 pin) cable (not supplied). S&H: USA \$4.95, Canada \$7.95 Other \$11.95

P16PRO PIC Programmer

• Program all 8, 18, 28 & 40 pin PICs in the 12C5xx, 14000 and 16Cxx series (except 16C54-58). • This kit uses the P16PRO shareware which is downloaded from the web and registered for \$20. • Visit www.electronics123.com for the complete list of PICs that can be programmed. • Can program 64 pin PICs with adapter (not supplied). • New PICs can be added.

PICALL PIC Programmer: As above but can also program 16C54-58. Price includes PICCALL software. (need internet for latest upgrade) Price \$79.95 Order Code: CPS117

PIC 16C/F84 Programmer: Software supplied on disk is for 16F84 • 16F84-4MHz PIC included! • EEPROM

• Separate erase command • Test command to check programmer & cable • Vpp (programming voltage) is under software control • Microchip data sheets on disk •

Software can read, verify & load (Win95/3.x/Dos)

\$28.95

Code: CPS81

For the beginner!

Toll Free 1-888-549-3749 (USA & Canada)

Tel (330) 549-3726. Request a FREE catalog or visit us at: www.electronics123.com for more products. Amazon Electronics, Box 21 Columbiana OH 44408

www.jm-micro.com

PIC In-Circuit Emulator

for the PIC16Cxx from \$295

PIC Programmer \$155

80C552 (8051) Development

Training System \$235

68HC11 SBC \$120

ROMY-16 EPROM Emulator

from \$195

Universal Microprocessor Simulator/Debugger (including Assembler, and Disassembler)

\$100 each CPU

J&M Microtek, Inc.

83 Seaman Rd, W Orange, NJ 07052

Tel:(973)325-1892 Fax:(973)736-4567

10 Hr. Telephone Recorder \$69 +\$6.95 S/H



FCC Approved



6 Hr. Tape included!

Automatically starts recording when the phone is picked up and stops when you hang up. Records both sides of the conversation!

Telephone recording controller only \$15

3 Hour Micro Telephone recorder with tape \$49

FREE CATALOG

www.msselectronics.com

MSC Electronics

PO BOX 461 Jessup, MD 20794

(301) 497-1600

FAX (301) 497-1925



MasterCard

</

**BK PRECISION®**

The 5300 Series, one of the world's finest digital multimeters. The best of the ASYC II Series, it has the best accuracy, a built-in counter, and displays AC voltage as resistive power or dB (impedance selectable), saving you the time of making the calculation. A careful examination of the performance features and user-conscious design will tell you that you hold a superior DMM in your hand, designed with measurement capability needed by users who demand the best.



MFG	MODEL	ACCY	LIST	SPECIAL PRICE
B&K	5360/MX53B	0.1%	\$229.00	\$129.00
B&K	5380/MX55	0.025%	\$309.00	\$139.00
B&K	5390/MX56B	0.025%	\$325.00	\$149.00

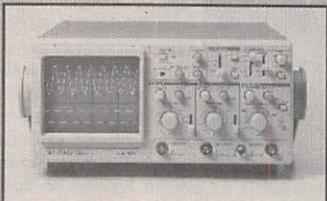
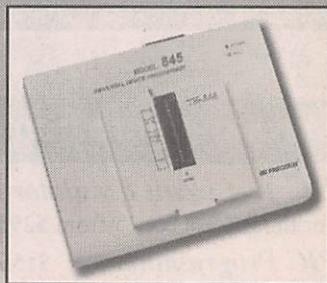
(resistive power on model #5390/MX56B)

• meters made in France by Metrix for B&K, feature 50,000 count capability, bargraph, true RMS, mains disturbance indication, good transient protection, a wide temperature range, conform to IEC 1010 class 2 safety compliance & 3 year warranty

The 845 is a software expandable universal device programming workstation that supports a wide variety of programmable devices with the added capability to test digital ICs. It is the most sophisticated low-cost programmer available today. A unique hardware/software architecture enables the Model 845 to easily grow in support and engineering software design capabilities as quickly as your device library requirement. State-of-the-art universal programmer offers you the most advanced programming facilities with the most user-friendly interface. Since each pin is software addressable, new part numbers can be added to the list of supported devices through software upgrades. The 845 interfaces with IBM, PC, XT, PS/2, AT, 386, 486, Pentium, portable or compatible personal computers. The standard pack-age allows you to directly connect to your PC through any standard parallel printer port (no special interface card or special modules needed).

MODEL	DESCRIPTION	REGULAR	SALE
840	Eeprom Programmer (single socket)	205.00	192.95
841	Eeprom Gang Programmer (4 sockets)	260.00	251.95
842	Universal Programmer	695.00	611.95
843	Universal Programmer (parallel port interface)	795.00	699.95
845	Universal Programmer (parallel port interface) Windows based	1295.00	1139.95
846	Universal Programmer (parallel port interface)	495.00	435.95
847	Universal Programmer (4 sockets, parallel port interface)	595.00	523.95

Universal Device Programmer & Logic IC Tester Model #845



KENWOOD

MODEL CS-4125
20 MHz, 2 Channel Oscilloscope, with probes & 3 year warranty
Suggested Price \$595.00

SUPER SPECIAL \$389.00 w/free t-shirt!!!



MODEL DESCRIPTION

CS-4135	40 MHz, 2 CH, 12 kV CRT w/scale illumination, 3 year warranty
CS-5350	50 MHz, 3 CH, Delayed Sweep, w/Readout & Cursors, 3 year warranty
CS-5355	50 MHz, 3 CH, Delayed Sweep, 3 year warranty
CS-5370	100 MHz, 3 CH, Delayed Sweep, w/Readout & Cursors, 3 year warranty
CS-5375	100 MHz, 3 CH, Delayed Sweep, 3 year warranty

REGULAR

855.00
1650.00
1485.00
2035.00
1815.00

SUPER SALE PRICE

685.00 w/free Kenwood t-shirt!
1235.00 w/free Kenwood Sweatshirt!
1115.00 w/free Kenwood Sweatshirt!
1525.00 w/free Kenwood Sweatshirt!
1360.00 w/free Kenwood Sweatshirt!

Electronic Training Videos From UCANDO

MODEL DESCRIPTION

VT401	AM Radio: Major stages of AM, signal conversion, signal detection, audio reproduction, AM stereo. 61 Minutes
VT402	FM Radio Part 1: Bandwidths, RF amplifier, mixer-oscillator, IF amplifier, limiter FM detector. 58 Minutes
VT404	TV Part 1, Intro to TV: Gain an overview of the television system and how the stages work together. 56 Minutes
VT405	TV Part 2, The Front End: UHF-VHF tuning stages, automatic fine tuning, remote control. 58 Minutes
VT406	TV Part 3, Audio: The sound strip, stereo TV, secondary audio programming, professional channels. 57 Minutes
VT501	Understanding Fiber Optics: Basic fundamentals, cable design, connectors, couplers, splicing. 58 Minutes
VT502	Laser Technology: Laser theory, types of lasers, applications, safety precautions. 57 Minutes

REGULAR

44.95	39.95
44.95	39.95
44.95	39.95
44.95	39.95
44.95	39.95



SAVE EVEN MORE!

Buy any six videos for only \$216.00. Order your UCANDO videos today!

PRINT™
Products International

Call, fax or email today for complete specs on any of the above products, and a copy of our 84 page test and measurement instrument catalog

8931 Brookville Rd * Silver Spring, MD, 20910

800-638-2020 * Fx 800-545-0058 * www.prodintl.com * sales@prodintl.com



MONDO • TRONICS'

ROBOT STORE

* KITS *

Your

* BOOKS *

Mailorder

* PARTS *

Source

* VIDEOS *

For

* MODELS *

Robots!

* MORE! *

(REQUEST OUR FREE CATALOG)

www.robostore.com

800-374-5764

Or write to us:

4286 Redwood Hwy #226-137

San Rafael CA 94903

Phone 415-491-4600 • Fax 415-491-4696

Email info@mondo.com

Low Cost PICmicro Tools



EPIC Pocket PIC Programmer - \$59.95

♦ Programs PIC12C50x, 67x, 16C55x, 6x, 7x, 8x

PICProto Boards - \$8.95 to \$17.95

PicBasic Compiler - \$99.95

new! PicBasic Pro Compiler - \$249.95

BASIC makes it easy for you to program the fast and powerful Microchip PIC microcontrollers.

♦ Expanded BS1/2 compatible instruction set
♦ True compiler provides faster program execution and longer programs than BASIC interpreters

microEngineering Labs, Inc.

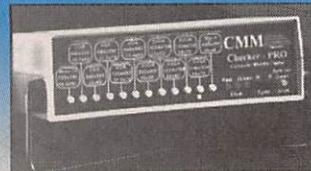
Box 7532 Colorado Springs CO 80933

(719) 520-5323 fax (719) 520-1867

<http://www.melabs.com>

CMM
Monitor/TV Test Equipment

Checker Pro



There is the Computer monitor tester you have been asking for. Sweep rates to 15-64 KHz, MGA, CGA, VGA, lots of MACs, even video (mono), GRAY SCALE, quick push button operation, "Energy Star" testing, and more. AC or Battery.

PRICE: \$499.95

Checker 12e



Now you can repair and test Computer monitors with ease. With sweep rates up to 64Khz., eight step gray scale, white screen, single color mode, Mac II, EGA, CGA support, you can run almost ANY PC monitor. And it is EASY to use. Color front panel displays show just what you should see. Don't let its' small size fool you. It is the most powerful handheld available, and it supports ALL basic VGA modes (some don't). It is suitable for bench or field operations. Battery or AC operation.

PRICE: \$295

Checker TV Pro & TV Jr.



The TV Pro is just the tool for your repair bench. It provides Video, S-Video, and RF outputs. It also has the most important pattern, GRAY SCALE! You can't set up a color TV without it. All with NTSC standards and COMPLEX sync. The RF output also includes an audio tone and STEREO signaling. With colorbars, gray scale, crosshatch with dots, you can set and test quickly.

Checker TV Pro...PRICE: \$499.95

The TV Jr. is a small NTSC video generator with colorbars crosshatch with dots, white, red, blue, green, and black screens. Small enough to fit in your pocket, powerful enough to drive the largest projection TV!

Checker TV Jr....PRICE: \$129.00

Computer & Monitor Maintenance, Inc.

VISA American Express

1-800-466-4411 • 770-662-5633

<http://www.computermonitor.com>

SURVEILLANCE HIDDEN CAMERAS DIRECT FROM MANUFACTURER-BEST PRICE IN THE MARKET

Ultra miniature hidden camera, in dome, smoke or motion detector w/ mic. B/W or Color. Wide view angle. Low light sensitivity. Super sharp images, plus video and audio output. From \$159.00. Also 1/3" B/W board cameras w/mic. Starts at \$79.00 USD. Plus \$5.95 for S/H. Worldwide welcome. COD check, Money Order or Visa/MC.

BOLIDE INTERNATIONAL CORPORATION
PH: (800) 355-0895 or (626) 575-8178
9660 Flair Drive #218, El Monte, CA 91731
<http://www.bolideamazingproducts.com/>

BUY BONDS



Test Equipment Sales

CHECK OUT THESE SPRING SPECIALS !



TEK 2236 100 MHz SCOPE W/ BUILT-IN FREQUENCY COUNTER.....\$895
 TEK 2246 100 MHz 4 CH. SCOPE W/ "Smartcursors" & ON-SCREEN R.O....\$1195
 B&K 2630 1 GHz SPEC. ANALYZER (NEW) w/ TRACKING GENERATOR.....\$3095
 HP 4277A LCZ METER.....\$3295
 ESI 296 AUTO DIGITAL LCR METER.....\$1195
 HP 8656B SIGNAL GENERATOR.....\$2595
 HP 8350B SWEEPER MAINFRAME.....\$2195
 GR 1863 MEGOHMMETER.....\$595
 AR 4040AT 3KV AC HYPOT TESTER.....\$575

FLUKE 5440B DCV CALIBRATOR.....\$1495
 FLUKE 8502A BECHTOP DMM.....\$495
 HP 1141A DIFFERENTIAL PROBE.....\$895
 HP 1142A PROBE POWER MODULE...\$275
 HP 1651A 32 CH. LOGIC ANALYZER.....\$1195
 HP 8642B SIGNAL GENERATOR.....\$14,900
 HP 3585A SPECTRUM ANALYZER.....\$5995
 HP 3325A SYNTH./FUNCTION GEN....\$1295
 HP 3577A NETWORK ANALYZER.....\$8950
 HP 3488A SWITCH CONTROL UNIT....\$495
 HP 5342A FREQUENCY COUNTER.....\$1650
 TEK 1241 LOGIC ANALYZER.....\$450

Ask about our line of new products including
 HP, LeCroy, Instek, Tektronix, Fluke and more !

CALL (800) 684-4651 OR FAX (603) 425-2945

M/C & VISA
ACCEPTED

CHECK US OUT AT WWW.TESALES.COM

CIRCLE 217 ON FREE INFORMATION CARD

BEST DEALER PRICING!

**CABLE
DIRECT**
CONVERTERS • FILTERS
DESCRAMBLERS

IMPROVE YOUR IMAGE WITH
VIDEO STABILIZERS

FREE
CABLE TV
CATALOG!

100%
MONEY BACK
GUARANTEE!



Now you can tune-in your favorite cable TV programming and **SAVE \$100'S - EVEN \$1000'S** on premium CABLE TV EQUIPMENT.



**MODERN
ELECTRONICS**
1-800-906-6664

2609 S. 156TH CIRCLE • OMAHA, NE 68130
<http://www.modernelectronics.com>

BEST BY MAIL

Rates: Write National, Box 5, Sarasota, FL 34230

GAMBLING

WIN AT HORSE RACING. INCREDIBLE! Free audio tape. WB, Box 1540, Minden, NV 89423.

GIFTS

BIG GREEN EGG. World's best smoker and grill, all ceramic, Lifetime Guarantee, www.BigGreenEgg.com/EGG2

MONEYMAKING OPPORTUNITIES

FREE: MAILERS NEEDED! Long Self-Addressed, Stamped Envelope: PAPST-(ELE), Box 679, Council Bluffs, ID 51502.

EXTRA INCOME! SASE: EMB Enterprises, Box 38602, Philadelphia, PA 19104-8602. Visit: <http://ordercom.com/actnow>

EARN MONEY AT HOME! No Selling! Call 1-800-811-2141 Code 54610.

MOTHER'S DREAM - WORK FROM HOME - (303) 337-3484, 24 Hours.

PERSONAL-MISCELLANEOUS

HEALTH PROBLEMS. Wealth needed. Please put Arthur in your will. Arthur F. Bothwell, P.O. Box 31, Wildwood, NJ 08260. Thank you. God bless you. Jesus Christ loves you.

WORLDWIDE CORRESPONDENCE 300,000 members. Write: International Pen Friends, Box 42232, Philadelphia, PA 19101-2232.

Zagros Robotics

World Class Engineering and Programming



PO Box 460342
St. Louis, MO 63146-7342
(314)768-1328

info@zagrosrobotics.com
www.zagrosrobotics.com

PC BOARDS

Low Cost, Precision-Made PC Boards
From Your Gerber/NC Drill Files

Put your CAD
program to
work for you!



- Milling
- Drilling
- Routing

www.pcbmilling.com FAX: (703) 818-0071

PicC C Compiler \$59

for Microchip's PIC microcontrollers
Supports PIC16C55x, 16C6x, 16C62x, 16C8x, 16C92x PIC families

SnXC C Compiler \$59

Supports ScenIX sx18ac and sx28ac microcontrollers

Both compilers based on ANSI C standard. Arrays, unions, structures, pointers, strings, function calls, if, for, switch, while, interrupt vectors, in-line assembler code, 8 & 16 bit variables, etc. Outputs Intel Hex format and assembly code. Code optimizer included. Excellent development tools!

DebugIDE Debugger \$79

C source level debugger for PicC and SnXC compilers. Integrated Development Environment. Step, Run, Stop, Reset. Variable monitoring and modification. Oscillator/cable kit (\$39)

732-873-1519 fax: 732-873-1582 e: grihrc@aol.com

Grih RC Inc. 120 Cedar Grove Ln, Ste 340, Somerset NJ USA 08873

URL: <http://members.aol.com/picccompile>

FCC License Preparation

Electronics Tech., Avionics, Marine & Radar
HOMESTUDY—Fast, Easy & Inexpensive
Manuals, Audio, Video, PC disks, latest Q&As
Free 1-800-800-7555 "Guaranteed Pass"

See at <http://www.worldaccessnet.com>

BusinessShowcase/wpt. 4701 NE 47th St.

Vancouver, WA 98661 - WPT Publications



340 East First Street
Dayton, Ohio 45402

Tons of Electronics

Get your FREE catalog today and discover some of the best deals in electronics. We have thousands of items ranging from unique hard-to-find parts to standard production components. Call, write or fax today to start your subscription to one of the most unique catalogs in the industry, filled with super values on surplus electronic and hobbyist type items.



Checkout our 10,000 item on-line catalog <http://www.meci.com>

Order Toll Free
1-800-344-4465

Why pay more?
Call today!

Fax Order Line
1-800-344-6324

CIRCLE 251 ON FREE INFORMATION CARD

ATTENTION DEALERS: WHOLESALE ONLY!



EXCLUSIVE:



2 PIECE SETUPS: \$85⁰⁰

10 lot • 1 Year Warranty

Latest Technology • Universal Combo's - Ask For Details
CALL US LAST! LOWEST PRICES GUARANTEED!

TOLL FREE:
800-375-3682



FAX:
516-246-5634

SUPERCIRCUITS

America's #1 Microvideo Source

AMAZING!

MICRO VIDEO TOP 10

OVER 120 NEW VIDEO PRODUCTS!

1. World's Smallest Video Camera* 1 lux, .3oz. \$59.95
2. Pinhole Video Camera 410 lines, 0.5 lux, Sharp chip \$39.95
3. Color Video Camera 350 lines, 2 lux, Remote head \$69.95
4. Live R/C Aerial Videotape How to's and more \$24.95
5. Wireless Covert Tape Cam 300' range, FCC OK \$349.95
6. Super Tiny Color Pinhole Cam 350 lines, 1" sq. \$99.95
7. Micro Video Transmitter 1000' range, ATV band \$159.95
8. Complete Wireless ATV Video Set 3 miles range \$419.95
9. World's Smallest Wireless Video Cam Please Call
10. Video Goggles Dual hi-res LCD's, 3D capable \$599.95

If you're looking for the best in microvideo...
Call us today and get our new 72 page catalog!

1-800-335-9777 ext ES

Or fax us at 512-260-0444

www.supercircuits.com

* See video from Supercircuits PC-67XS spacecam on our web site...also live R/C plane aerials!

Used on
NASA Space
Flight*

Start an exciting career as a Telecommunications Technician



Train at home in
your spare time for
an exciting new
career! Earn as
much as \$35,000 a
year and more
working with fiber
optics, radar and
cellular networks.

This ICS program is endorsed by the
National Association of Radio and
Telecommunications Engineers (NARTE)
and features a voucher for the NARTE
Class IV Technician Certification exam.

Mail Coupon below for **FREE** facts
or call toll free

1-800-595-5505 ext. 3107

Call Anytime — 24 hours a day, 7 days a week.
<http://www.icslearn.com> AG01

YES! Please send me free information on how I can
train at home for a career as a Telecommunications
Technician. There's no obligation.

Name _____ Age _____

Street _____ Apt. # _____

City/State _____ Zip _____

Phone () _____



**International
Correspondence Schools**

A Subsidiary of Harcourt Brace & Company
Dept. ADE069S, 925 Oak Street, Scranton, PA 18515

CABLE TV EQUIPMENT

Converters, Test Cubes & Chips

Video Stabilizers

1 Year Warranty
30 Day Money
Back
Guarantee



"ABSOLUTE LOWEST
WHOLESALE &
RETAIL PRICES"
CABLE U.S.A.

1-888-388-CUBE

Building a Micro Robot ?

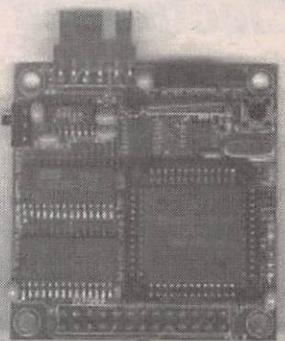
MicroCore-11™

- tiny 2" x 2" stackable 68HC11 microcontroller module
- 32K SRAM plus 8K or 32K EEPROM
- RS232, 5V regulator, 8MHz xtal
- download programs via your PC serial port
- use assembler or BASIC (both included)
- 8K Starter Package #MC11SP8K.....US\$75.00
- 32K Starter Package #MC11SP32K.....US\$89.00
- Motor driver board and accessories available.

Technological
Arts

26 Scollard Street
Toronto, Ontario
Canada M5R 1E9
Phone: (416) 963-8996
Fax: (416) 963-9179

www.technologicalarts.com



MAY THE
SOURCE
BE WITH
YOU

Don't let the dark forces of
ignorance defeat you. Right in this
galaxy you can tap into the source—
the free Consumer Information
Catalog. It lists free and low-cost
federal publications on a variety
of important topics.

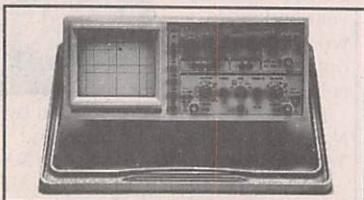
So dispel the darkness and get the
source. Call toll-free 1-888-8 PUEBLO for your free Catalog. Or set your
coordinates for the Consumer Information Center Web site:

www.pueblo.gsa.gov

New and Pre-Owned Test Equipment



Goldstar



Model OS-5100 → \$899.00

Full 100 MHz Bandwidth!

- Dual-Channel, High Sensitivity
- TV Synchronization Trigger
- Calibrated Delayed Sweep
- Includes Two Probes, 2 Year Warranty

Spectrum Analyzer
Avcom PSA-37D

Satellite Downlink
Installation
Maintenance & Service

- Band 1 10 - 1750 MHz
- Band 2 3.7 - 4.2 GHz
- Built-in DC Block & Power for LNA/LNB's
- Line or Battery Powered

Only \$2,475.00!

We Buy Surplus
Test Equipment

Leader CATV Signal Level Meter Model LF 941

✓ TV/CATV Coverage from 46 - 870 MHz

✓ Video/Audio Carrier Measurements \$695.00!

Just Released! → "Series III" Multimeters

Fluke Model 87III \$319.00 !!!

**SIMCHECK® II PLUS
Module Tester**

- * Tests SIMMs/168 p DIMMs
- * Stand alone/portable
- * Identifies Module properties
- * Advanced Setup Capabilities

Only \$2750.00!

(1-800-996-3837)

See us on the Web!
www.fotronic.com

Test Equipment Depot

A FOTRONIC CORPORATION COMPANY

99 Washington St. Melrose, MA 02176

(781) 665-1400 • FAX (781) 665-0780

email: sales@fotronic.com



TOLL FREE 1-800-99-METER

PROFESSIONAL DESOLDERING with the World's Best Transportable, Totally Self-Contained Desoldering Tool

Now Get

More Vacuum

Mike Murphy - Service Center - Van Nuys CA 818-785-7805

The single best investment of repair equipment we've made. It outperforms all other desoldering tools we've used. Easier to use and least expensive.

Dick Manning - Dicks Electronics - Hartland WI 414-367-8339

The ease & speed of component removal greatly increases productive time. The SMD kit makes SMD removal a breeze, even for inexperienced Techs.

Quicker Vacuum

LAV Electronics - Healeah-Miami Lakes FL

I am a constant user of the SC7000 Desoldering Tool and for quick component removal, this unit has no equal. It also comes with excellent company support. I am very satisfied and highly recommend it to anyone in the servicing field.

George Hefner - Hefner Electronics - Coleridge NE 402-283-4333

Being a one-men service center, I hesitated to spend the money on a desoldering tool, however all that changed when I nearly ruined a \$400 computer logic board. It has cut my desoldering time by 50%.

Higher Temperature

Don Cressin - Certified Electronics Service - Ellicott City MD 301-461-8008

We have obtained excellent results with the SC7000 including repairing high density U/V tuners. It is one of the best purchases we have made.

Doug Pettit - LuRay Electronics - LuRay VA 703-743-5400

We found that the SC7000 not only saves money vs. wick, but saves valuable time in troubleshooting. It allows you to be more accurate in removing SMD's.

**Sale Price
\$395.00**

New Features

- Totally Self Contained diaphragm vacuum pump and AC motor for high vacuum suction or reversible hot air blow for SMD removal.
- 100 Watt Ceramic heater with zero-crossover switching heater control circuit which prevents spikes and leakage currents.
- Unique patented long lasting filter cartridge design. Solder builds up on easily cleaned baffle, while air flows around the outside of baffle.
- Totally ESD Safe. The housing contains carbon and the tip is at ground potential for complete ESD Protection.

Howard Electronic Instruments, Inc.
6222 N. Oliver Kechi, KS 67067



FREE TRIAL

Available on Request

Price includes
stand worth \$25.00
one extra filter, and
two tip cleaners.

Timothy Kraft - Monikraft, Inc.
Cherry Hill NJ 609-751-3252

We replaced all our existing desoldering stations with the SC7000. Our technicians are very pleased with the improved performance, portability, and reliability over our previous higher priced equipment.

Bill Warren CET/CSM -
Warren's Audio & Video -
Knoxville TN - 234-546-1128

We have been extremely satisfied with the quality and durability of the DEN-ON SC7000 as well as with after the sale support.

Keith Salis - J & M Electronics
Omaha NE 402-291-7100
It's a must tool for my bench. I can desolder multiple pin IC's quickly and clean. It will even take up large solder amounts on tuner and case grounds.

For More Info

and 5% Savings Go To

<http://www.heinc.com/sc7000zb.html>

New Specifications

- Voltage AC 100v, 120V, 230V, 50/60 HZ
- Power Consumption 120W
- Pump Diaphragm Type
- Motor Output 12W
- Vacuum Attained 650mm Hg
- Temperature Range 300° C - 500° C (572° F - 932° F)
- Air Flow Rate 15 Liter/Minute (Open)
- Heater 100W (Ceramic)
- Control System Feed Back Zero Cross-over Type
- Net Weight 420 Grams

Visa - M/C - Discover - American Express - Terms to Qualifying Companies

30 Day Money Back Total Satisfaction Guarantee - One Year Parts and Labor Warranty

HOWARD
HELECTRONIC
INSTRUMENTS INC
Your Desoldering Specialists

Toll Free U.S. and Canada
1-800-394-1984

Web Site www.heinc.com
E-Mail sales@heinc.com
International (316) 744-1993
or Fax (316) 744-1994

AMAZING PRODUCTS!

INFORMATION

VISIT OUR "ACTION" WEB SITE @
UNLIMITED DEPT GEN+ 1198 <http://www.amazing1.com>
BOX 716 AMHERST, N.H. 03031

PLASMA BALLISTIC GUN

SHOOTS A HIGH VELOCITY PROJECTILE

Uses New Technology to Generate High Propellant Pressure Without Chemical Reactions

Velocities Up To 3000 m/sec with 50mg Projectile!!

Easily Scaled Up or Down

Easy to Build-Kit and Parts Available

Approximately .16 Caliber Bore

PPR01 Plans, Parts Lists and Sources.....\$20.00

Includes Our HEP Series Plans Used for **RAILGUNS, COIL GUNS, EMP LEVITATION, ANTIGRAVITY, MASS WARPING, LATTICE SNAPPING** etc

JACOBS LADDER

Observe a pyrotechnical display of "traveling" fiery plasma.

Starts off as 1/2" arc and expands to over 3" before evaporating into space. This is an excellent attention getting display as well as a winning science project!! With arc control.



JACK1 Plans.....\$8.00
JACK1K Kit Minus Case.....\$129.95
JACK10 Ready to Use.....\$249.95

12KVGGEN20 Pwr Supply Only.....\$99.95
12KVGGEN2K Kit of Pwr Supply.....\$79.95

3Mi FM VOICE TRANSMITTER

Safety Product Allows Listening to Children or Invalids in Hazardous Areas, Pools, Ponds etc. Great Security Intrusion Alert! Uses FM Table Top Radio. Become the local neighborhood DJ.



FMV1K Kit/Plans.....\$39.95

ALL NEW CYBERNETIC EAR!

Enhances Normal Hearing 3 to 4 Times. Provides That Extra "Edge" for Hunters. Trackers Nature Enthusiasts

Adjustable Volume Control
Fits Into Either Ear
Built In Long Lasting Batteries
CYBEREAR Ready to Use.....\$19.95

PHASOR PAIN FIELD PISTOL

Blast out rats and rodents with high power Shock Waves
Handheld and Battery Operated

PPPI Plans.....\$8.00
PPPIK Kit/Plans.....\$49.50
PPPI0 Ready to Use.....\$79.50

MICRO TESLA COIL

Lights up a 4 ft
Fluorescent Tube
Without Contact!!
Yet Only 3" Tall!!

Super Magic Trick
Low Cost Science Project
12 VDC/115 VAC Operation
MTC1K Kit/Plans.....\$19.95
MTC10 Ready to Use.....\$34.95

HOVERBOARD PLANS

Research Project

Kit Soon to be Available

28 Pages of "how to" build a magnetic force field capable of containing a column of ionized air up to several psi! Includes theory on how to build a HOVERBOARD prototype capable of lifting 200 lbs.
HOVER Plans and Data.....\$25.00

TAKE CONTROL!! ELECTRONIC HYPNOSIS & MIND MACHINES

Electronic Circuitry Induces Hypnotic as Well as ALPHA Relaxed States of the Mind. Place Subjects "Under" Your Control. Enhances Hidden PSYCHIC Ability in Many People!



MIND Plans.....\$15.00
MIND2K Kit and Plans.....\$49.95
MIND20 Assembled.....\$89.95

TELEPHONE TAPING SYSTEM

EXTENDED X4 PLAY
Tapes Both Sides of Phone Conversation - Check Laws!
TAP30X Ready to Use.....\$84.95
BEEP10 Beeper Alert.....\$29.95

TRANSISTORIZED TESLA COIL

TURNS A LIGHT BULB INTO A SPECTACULAR PLASMA DISPLAY
Transmits Wireless Energy. Brush and Corona Discharge. Noiseless Operation. Pyrotechnic Effect. 12 VDC/5 Amps or Battery 115 VAC Optional Converter. Adjustable Frequency Control For Effect.



Shown With Oil Fill Option
TCL5 Plans.....\$8.00
TCL5K Kit/Plans.....\$59.95
TCL50 Ready to Use.....\$109.95
12DC/7 12VDC@7Amps.....\$39.95

1 800 221 1705 ORDERS ONLY! FAX 1 603 672 5406 INFO 9-5pm 1 603 673 4730 FREE CATALOG ON REQUEST

Pay by MC, VISA, Cash, Chk, MO, COD. Please Add \$5.00 S&H plus \$5.00 if COD. Overseas Please Contact for PROFORMA

Miniature Transmitters and Receivers

2 Button / 3 Channel Transmitter



RF300T

1....\$22.95
5....\$19.95 ea
10....\$16.95 ea

RF300XT

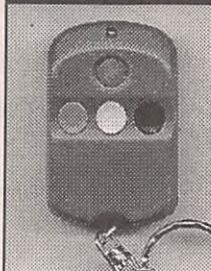
1....\$25.95
5....\$22.95 ea
10....\$19.95 ea

- 300' (XT), 150' (T) Range
- Frequency: 318 MHz
- 59,049 Settable Security Codes
- 12 Volt Battery and Keychain Included
- Current Draw: 4.8 ma
- Fully Assembled in Case
- Dimensions: 1.25" x 2.0" x .5"
- Push both buttons for the 3rd Channel
- Slide Button Cover Included

- Alarm Systems
- Garage / Gate Openers
- Lighting Control

- Magic Props
- Medical Alert
- Monitoring Systems

4 Button / 15 Channel Transmitter



RF304XT

1....\$27.95
5....\$24.95 ea
10....\$21.95 ea

- 250' Range
- Frequency: 318 MHz
- 6,561 Settable Security Codes
- 12 Volt Battery and Keychain Included
- Current Draw: 4.6 ma
- Fully Assembled in Case
- Dimensions: 1.35" x 2.25" x .5"
- Push combination of buttons to achieve up to 15 channels

- Industrial Controls
- Surveillance Control
- Motor Control

2-4 Data / 3-15 Channel Receivers



RF300RL
RF300RM

1....\$27.95
5....\$24.95 ea
10....\$22.95 ea

RF304RL
RF304RM

1....\$29.95
5....\$26.95 ea
10....\$23.95 ea

- Compatible with 300/4 Transmitters
- 11-24 volts DC Operating Voltage
- 13 ma. Current Draw
- Latching (L) or Momentary (M) Output
- Kits Available (subtract \$5.00 ea.)
- Dimensions: 1.25" x 3.75" x .5"
- 2 (300) / 4 (304) Output Data Lines
- Binary to Dec / Hex Converter can achieve up to 15 channels

- Schematics Available
- Receiver Board Layout Available
- Custom Design Consulting Available

Visitect Inc.

(510) 651-1425 Fax: (510) 651-8454
P.O. Box 14156, Fremont, CA 94539

Email: Support@Visiect.Com
Visa / Mastercard, COD

ALL ELECTRONICS

C O R P O R A T I O N

QUALITY
PARTS

FAST
SHIPPING

DISCOUNT
PRICING

CALL, WRITE, FAX
or E-MAIL For A
Free 96 Page
CATALOG.

Outside the U.S.A.
send \$3.00 postage.

SCSI INTERFACE 12X SPEED CD-ROM DRIVE

Toshiba # XM-5701B
New, 12X disc drive. SCSI
interface internal drive
measures 1.62"(h)
x 5.69"(w) x
7.41"(d).
For
ease of
set-up,
comes with
SCAM (SCSI
Configuration AutoMagnetically) which automatically configures all aspects of the CD-ROM
drive with the computer when connected through a SCSI port to a PC or Macintosh.
Data transfer at 1800KB/s. 115ms average
random seek time.
256K buffer.

CAT # XM-5701B **\$22.50** each

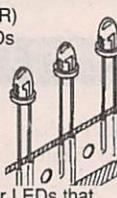
3000 MCD ULTRA-BRIGHT RED LED

Everlight # 383URC-2/TR1-C(R)
Red, "Ultra-bright" T 1 3/4 LEDs
now at our lowest price ever.
Due to a special purchase of
"tape-and-reel" parts we are
able to offer these LEDs at an
incredibly low price when pur-
chased on the reel. These
are 5 mm diameter water-clear LEDs that
light bright red at 20 mA.

CAT # LED-50

2 for \$1.00

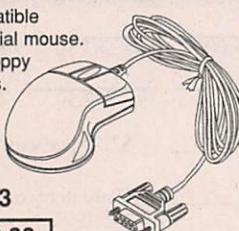
100 for \$35.00
1000 for \$250.00
(25¢ each)



3 BUTTON Serial MOUSE

Windows compatible
three button serial mouse.
Includes 3.5" floppy
disk with drivers.

\$3.50
each



CAT # MSE-3

10 for \$30.00

ORDER TOLL FREE

MAIL ORDERS TO:
ALL ELECTRONICS CORP.
P.O. BOX 567
VAN NUYS, CA 91408-0567

1-800-826-5432

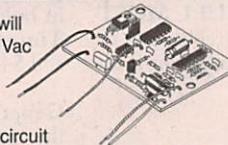
FAX (818) 781-2653 • INFO (818) 904-0524
INTERNET <http://www.allcorp.com/>
E-MAIL allcorp@allcorp.com

NO MINIMUM ORDER • All Orders Can Be Charged to Visa, Mastercard, American Express or Discover • Checks and Money Orders Accepted by Mail • Orders Delivered in the State of California must include California State Sales Tax • NO C.O.D. • Shipping and Handling \$5.00 for the 48 Continental United States - ALL OTHERS including Alaska, Hawaii, P.R. and Canada Must Pay Full Shipping • Quantities Limited • Prices Subject to change without notice.

MANUFACTURERS - We Purchase EXCESS INVENTORIES... Call, Write, E-MAIL or Fax YOUR LIST.

30 Minute Timer Board

Timer circuit board will
operate 120 or 240 Vac
devices. Originally
designed to run a
vibrating motor in a
massage chair, the circuit
automatically shuts-off a motor, lamp or other
device after approximately 30 minutes. Shut-
off time can be varied by replacing one of the
resistors on the board with a pot or resistor of
different value. Hook-up instructions included
with the board explain how to
make this modification.
1.9" x 2.5". CAT# TMR-5



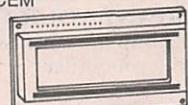
\$3.50
each

20 Character X 4 Line LCD

Optrex # DMC 20434-CEM
(PWB 20434-CEM)
5 x 8 dot format.
3" x 1" viewing area.
3.88" x 2.38" module.
Removed from new
equipment. May have felt padding on metal
bezel. 14 pin single row header is pre-attached.
Spec/hook-up sheet included.

CAT# LCD-46 **\$7.00**
each

10 for \$60.00



Microphone For Fish

Consists of a dart-shaped underwater trans-
ducer on a 21' wire and a small
amplifier. According to the man-
ufacturer, it enables
you to hear the fish stri-
king your bait, thus
allowing you to
catch more fish. We
don't have the instruc-
tions, and you will need some head-
phones with a 3.5 mm phone plug. Also
requires 4 AAA batteries (not included).
Transducer is 3.3" long. Amplifier
assembly is 3.5" x 2.4" x 1".



CAT # AQS-1 **\$5.00**
each

45 Amp Solid State Relay

Crouzet/Gordos # G240D45
Control Voltage: 3-32 Vdc
Load: 45 Amps, 24-280 Vac
Back-to-back (dual) SCR output for severe induction loads.
False turn-on immunity and positive
turn-off at high dv/dt. Standard "hockey-puck"
2.25" X 1.75" X 0.90". UL/CSA
CAT# SSRLY-45



\$19.50
each

Surface Mount Momentary Pushbutton Switch

Panasonic # EQV PHV03T
S.P.S.T., normally open,
surface mount pushbutton. 0.25"
square x 0.13" high. Leads on
0.15" centers.

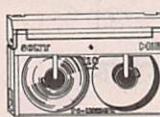


CAT # PB-85 **3 for \$1.00**

100 for \$25.00 • 2000 per reel \$200.00

"Hi-8" Video Cassette

SONY Hi-8 Top quality,
metal particle 120 minute
video cassettes. Used
for a short time, then
bulk-erased. Each
cassette has its own
plastic storage box.



CAT # VCU-8 **\$3.00**
each

10 for \$28.00 • 100 for \$250.00

NEODYMIUM MAGNET

0.25" Diameter X 0.25" Long
Small cylindrical magnet with metallic
coating. CAT # MAG-45



2 for 80¢ • 10 for \$3.50 • 100 for \$25.00

12 Volt Lamp and Socket

A great lamp assembly for
display or special
effects lighting.



Consists of a remov-
able 12V, 1.2A wedge
base bulb (# 921, 12C21CP)
and a socket with a reflective
chrome shade. Assembly is
2.6" X 0.95" X 0.75". 19" pigtail leads.
Large quantity available.

CAT# LMP-7 **\$1.25**
each

10 for \$10.00 • 100 for \$70.00



USE ELECTRONICS NOW CLASSIFIEDS

READ BY ELECTRONIC BUYERS AND SELLERS AND TRADERS

INSTRUCTIONS FOR PLACING YOUR AD!

HOW TO WRITE YOUR AD

TYPE or PRINT your classified ad copy CLEARLY (not in all capitals) using the form below. If you wish to place more than one ad, use a separate sheet for each additional one (a photo copy of this form will work as well). Place a category number in the space at the top of the order form (special categories are available). If you do not specify a category, we will place your ad under miscellaneous or whatever section we deem most appropriate.

We cannot bill for classified ads. **PAYMENT IN FULL MUST ACCOMPANY YOUR ORDER.** We do permit repeat ads or multiple ads in the same issue, but in all cases, full payment must accompany your order.

WHAT WE DO

The first word and company name of each ad are set in bold caps at no extra charge. No special positioning, centering, dots, extra space, etc. can be accommodated.

RATES

Our classified ad rate is \$2.50 per word. Minimum charge is \$37.50 per ad per insertion (15 words). Any words that you want set in bold are each .40 extra. Indicate bold words by underlining. Words normally written in all caps and accepted abbreviations are not charged anything additional. State abbreviations must be post office 2-letter abbreviations. A phone number is one word.

If you use a Box number you must include your permanent address and phone number for our files. ADS SUBMITTED WITHOUT THIS INFORMATION WILL NOT BE ACCEPTED.

For firms or individuals offering Commercial products or Services. **Minimum 15 Words.** 5% discount for same ad in 6 issues within one year; 10% discount for same ad in 12 issues. **Boldface** (not available as all caps), add .40 per word additional. **Entire ad in boldface**, add 20%. **Tint screen behind entire ad**, add 25%. **Tint screen plus all boldface ad**, add 45%. **Expanded type ad**, add \$4.00 per word.

General Information: A copy of your ad must be in our hands by the 13th of the fourth month preceding the date of issue (i.e. Sept issue copy must be received by May 13th). When normal closing date falls on Saturday, Sunday or Holiday, issue closes on preceding work day. Send for the classified brochure.

DEADLINES

Ads not received by our closing date will run in the next issue. For example, ads received by November 13 will appear in the March issue that is on sale January 17. ELECTRONICS NOW is published monthly. No cancellations permitted after the closing date. No copy changes can be made after we have typeset your ad. NO REFUNDS, advertising credit only. No phone orders.

CONTENT

All classified advertising in ELECTRONICS NOW is limited to electronics items only. All ads are subject to the publishers' approval. WE RESERVE THE RIGHT TO REJECT OR EDIT ALL ADS.

AD RATES: \$2.50 per word, Minimum \$37.50

Send you ad payments to:

ELECTRONICS NOW 500 Bi-County Blvd, Farmingdale, NY 11735-3931

CATEGORIES

100 -- Antique Electronics	270 -- Computer Equipment Wanted	450 -- Ham Gear Wanted	630 -- Repairs-Services
130 -- Audio-Video Lasers	300 -- Computer Hardware	480 -- Miscellaneous Electronics For Sale	660 -- Satellite Equipment
160 -- Business Opportunities	330 -- Computer Software	510 -- Miscellaneous Electronics Wanted	690 -- Security
190 -- Cable TV	360 -- Education	540 -- Music & Accessories	710 -- Telephone
210 -- CB-Scanners	390 -- FAX	570 -- Plans-Kits-Schematics	720 -- Test Equipment
240 -- Components	420 -- Ham Gear For Sale	600 -- Publications	730 -- Wanted

CLASSIFIED AD COPY ORDER FORM

Place this ad in Category # _____

Special Category \$30.00 Additional _____

1 - \$37.50 2 - \$37.50 3 - \$37.50 4 - \$37.50

29 - \$72.50 30 - \$75.00 31 - \$77.50 32 - \$80.00

5 - \$37.50 6 - \$37.50 7 - \$37.50 8 - \$37.50

33 - \$82.50 34 - \$85.00 35 - \$87.50 36 - \$90.00

9 - \$37.50 10 - \$37.50 11 - \$37.50 12 - \$37.50

37 - \$92.50 38 - \$95.00 39 - \$97.50 40 - \$100.00

13 - \$37.50 14 - \$37.50 15 - \$37.50 16 - \$40.00

Total words _____ \$2.50 per word = \$ _____

17 - \$42.50 18 - \$45.00 19 - \$47.50 20 - \$50.00

Bold Face _____ \$0.40 per word = \$ _____

21 - \$52.50 22 - \$55.00 23 - \$57.50 24 - \$60.00

Special Heading _____ \$30.00 = \$ _____

25 - \$62.50 26 - \$65.00 27 - \$67.50 28 - \$70.00

Other _____ = \$ _____

Total classified ad payment \$ _____ enclosed

TOTAL COST OF AD \$ _____

Check Mastercard Visa Discover Card # _____ Expiration Date ____ / ____

Signature _____

Name _____ Phone _____

27pc•kit

\$12.95

K2637

MINIATURE AUDIO AMPLIFIER KIT

Big sound from a small unit !

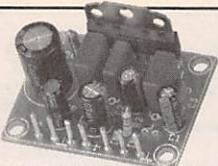
Small PCB with both pre- and power amp

Short circuit protected

Input sensitivity : 20mV

Max. output power : 2.5W

Power supply : 4.5 to 15VDC



28pc•kit

\$12.95

K1771

FM OSCILLATOR KIT

Use for home broadcasts, baby monitoring, security

Frequency range : 100-108MHz

Microphone input

No coils to wind

Power supply : 9-12VDC



17pc•kit

\$9.95

K1803

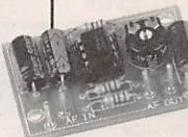
UNIVERSAL MONO PRE-AMPLIFIER KIT

Boost any audio signal up to 40dB (x100)

Max input signal : 40mV

Frequency range : 20Hz to 20KHz

Power supply : 10-30VDC/10mA



19pc•kit

\$19.95

K5300

STROBOSCOPE KIT

Stage effects at home

Adjustable flash rate: 2-20 flashes/second

Powerful flash tube

Supply voltage : 110-125V AC

16pc•kit

\$14.95

K6708

IR REMOTE CONTROL KEY CHAIN

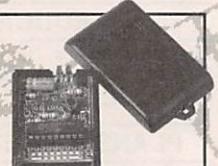
TRANSMITTER For K6709 Kit

Range : Up to 24 feet

LED operation indicator

8748 different code settings

Power supply : 12V battery



36pc•kit

\$18.95

K4304

10 LED VU METER KIT

Visualise any audio level

Line or speaker inputs

DOT or BAR mode. Range : -20 to +3dB

Front panel included. Vertical or horizontal mounting. Power supply 10-15VDC



27pc•kit

\$24.95

K5002

HALOGEN LAMP DIMMER KIT

Light control at the touch of a button

Suitable for loads up to 3A

Can control small motors with brushes

Push button operation

Add any number of buttons

Power supply : 110-125V AC

12pc•kit

\$12.95

K1823

1 AMP POWER SUPPLY

Just add a transformer

Adjustable output voltage

1.5V to 35V/1A max.

Short circuit and thermal protection

Max input voltage : 37VDC

Max dissipation : 15W

18pc•kit

\$14.95

18pc•kit

K6700

2-WIRE REMOTE CONTROL TRANSMITTER

Transmitter For K6701 Kit

Control up to 16 devices*, with

only 2 wires ! Remotely control 8

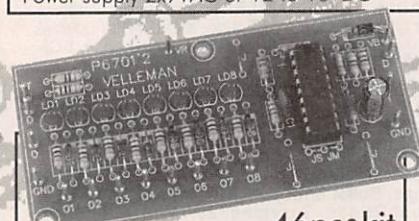
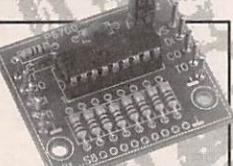
(*16 with 2 units) devices up to

160 feet away. Transmitter is powered

over the data wires. Simple operation by

means of switches (not included)

Transmitter can drive multiple receivers



46pc•kit

\$24.95

K6701

2-WIRE REMOTE CONTROL RECEIVER For K6700 Kit

8 open collector outputs (max 200mA)

LED output status indication

Daisy chain 2 units for 16 outputs

Power supply : 6-16V DC

18pc•kit

\$14.95

K2579

UNIVERSAL START STOP TIMER KIT

0-15 Minutes Adjustable Delay

3A changeover relay contact

Start and Stop button included

LED function indicator

Can be modified for longer delays

Power supply : 12V/55mA

18pc•kit

\$14.95

7415 Whitehall Street Suite 119

Fort Worth, TX 76118

(817) 284-7785 F : (817) 284-7712

www.velleman.be email : velleman@earthlink.net

Questions ? Contact us for a list of US distributors or to get your **FREE** catalogue

CIRCLE 282 ON FREE INFORMATION CARD

PO Box 2426, Ft. Walton Beach, FL 32549

Visit our
ON-LINE
CATALOG



Voice/Fax 850-863-5723

Stackable RS-232 Kits

Digital I/O - 12 I/O pins individually configurable for input or output. DIP switch addressable; stack up to 16 modules on same port for 182 I/O points. Turn on/off relays. Sense switch transitions, button presses, 4x4 matrix decoding using auto-debounce and repeat. **\$32**

Analog Input - 8 input pins. 12-bit plus sign self-calibrating ADC. Returns results in 1mV steps from 0 to 4095. Software programmable alarm trip-points for each input. DIP switch addressable; stack up to 16 modules on same port for 128 single-ended or 64 differential inputs. **\$49**

Home Automation (X-10) - Connects between a TWS23 and your serial port. Receive and transmit all X-10 commands with your home-brewed programs. Full collision detection with auto re-transmission. **\$39**

Caller ID - Decodes the caller ID data and sends it to your serial port in a pre-formatted ASCII character string. Example: "12/31 08:45 850-883-5723 Weeder, Terry <CR>". Keep a log of all incoming calls. Block out unwanted callers to your BBS or other modem applications. **\$35**

Touch-Tone Input - Decodes DTMF tones used to dial telephones and sends them to your serial port. Keep a log of all outgoing calls. Use with the Caller ID kit for a complete in/out logging system. Send commands to the Home Automation or Digital I/O kits using a remote telephone. **\$34**

www.weedtech.com

Telephone Call Restrictors

Two modes of operation; either prevent receiving or placing telephone calls (or call prefixes) which have been entered into memory, or prevent those calls (or call prefixes) which have "not" been entered.

Block out selected outgoing calls. Bypass at any time using your password. **\$35**

Block out selected incoming calls. Calls identified using Caller ID data. **\$48**

IR Remote Control Receiver

Learns and responds to the data patterns emitted by standard infrared remote controls used by TVs, VCRs, Stereos, etc. Lets you control all your electronic projects with your TV remote. 7 individual output pins can be assigned to any button on your remote, and can be configured for either "toggle" or "momentary" action. **\$32**

DTMF Decoder/Logger

Keep track of all numbers dialed or entered from any phone on your line. Decodes all touch-tones and displays them on a 16 character LCD. Holds the last 240 digits in a non-volatile memory which can be scrolled through. Connect directly to radio receiver's speaker terminals for off-air decoding of repeater codes, or numbers dialed on a radio program. **\$55**

AUDIO-VIDEO-LASERS

Unique Video Products Pattern Generators with character identification, composite, S-video, RGB, distribution amplifiers, kits also available. FREE catalog, **GEKCO Labs**, PO Box 642 Issaquah, WA 98027-0642, 425-888-5756, www.gekco.com

BUSINESS OPPORTUNITIES

Have an idea? If so, we are a national company working with ideas, inventions, new products. Patent services. Call 1-800-288-IDEA.

\$400 Weekly Assembling electronic circuit boards/products from home. For free information send SASE: **Home Assembly-EN** Box 216 New Britain, CT 06050-0216.

EASY WORK! EXCELLENT PAY! Assemble Products At Home. Call Toll Free 1-800-467-5566 Ext. 5192.

FREE MONEY! Never Repay. Guaranteed. Business Start, Expansion, Personal Needs, Debt Consolidation. **FREE** Information 1-818-377-5051.

CABLE TV

Cable TV descramblers. One-piece units. Scientific Atlanta, Jerrold, Pioneer, and others. Lowest prices around. **Precision Electronics**, Houston, TX anytime. 1-888-691-4610.

CABLE DESCRAMBLING, New secret manual. Build your own descramblers for cable and subscription TV. Instructions, schematics for SSAVI, Gated Sync, Sinewave, \$12.95, \$2 postage **CALETRONICS**, Box 30502E, Bethesda, MD 20824.

New! Jerrold and Pioneer wireless test units \$125 each, also 75dB notch filters \$19.95 each, quantity pricing available please call **KEN ERNY ELECTRONICS** 24-hour order and information hot line 516-389-3536.

Cable boxes all models, all channels, lowest prices in the United States. Open seven days a week till midnight, Pacific Time. Call (877) 789-7337 Toll-Free.

Pay TV & Satellite descrambling 1999 Edition. All the latest cable and satellite fixes \$16.95. Complete Pay TV series (282 pages) \$59.95. Hacking satellite systems video \$29.95. Scrambling News subscription with web access \$34.95. Everything listed above \$99.95. Free catalog. **Scrambling News**, 4798 South Florida Ave., Lakeland, FL 33813. 941-646-2564. C.O.D.'s are O.K. Add \$6.00.

CABLE TV DESCRAMBLERS. ALL MAJOR BRANDS. RFTS. HAVE MAKE AND MODEL NUMBER OF CONVERTER USED IN YOUR AREA WHEN CALLING. QUANTITY DISCOUNTS. K.D. VIDEO 1-800-327-3407.

CABLE DESCRAMBLERS, including activators for all Jerrold Dp5-CFT 22xx's and SP's. Lowest single or lot prices. Also, RFT-Dams Zenith, **SCIENTIFIC ATLANTA**, and **PIONEER**. Se habla en español. Call 888-684-9277.

ALL CABLE TV BOXES. WE'LL BEAT ANY PRICE. 30 DAY TRIAL 1 YEAR WARRANTY. 1-800-538-CABLE(2225).

Descramblers, Converters, Activators, RFT's, FTG's, Bullet Snappers, All Options Explained, Best Prices, Services, 2yr. Warranty, Free Catalog 1-800-854-1674 www.resource-leader.com/aipc

DESCRAMBLERS Scientific Atlanta 8580 with remote. Original factory one piece unit. Like new. 99 channels. Guaranteed \$190.00, five lot \$150.00 **NOVICOR ELECTRONICS** 412-833-0773

WHOLESALE PRICES, SUPERIOR QUALITY, INTERNAL AND EXTERNAL ACTIVATORS. 1ST TIME DISCOUNT. \$200.00 MIN, COD ONLY. 24/7 MESSAGE SERVICE. SALES OPEN M-F 8:00 AM TO 4:30 PM. CALL LUNAR INDUSTRIES 1-800-289-9566.

CB-SCANNERS

CB Radio Modifications! Frequencies, kits, high-performance accessories, books, plans, repairs, amps, 10-Meter conversions. The best price since 1976! Catalog \$3.00. **CBCI** Box 1898 EN, Monterey, CA 93942. www.cbcit.com

CB Trick Books, three books 1, 2 and 3. Each book \$19.95 each. Repairs, tune ups, and amplifiers. Send money order to **Medicine Man CB** PO Box 37, Clarksville, AR 72830.

COMPUTER HARDWARE

ROBOT Module. Security Robot Kit. Free Catalog. www.actionrobotics.com. **ACTION ROBOTICS** Box 138, Boston, NY 14025

EDUCATION

Learn Electronics. Home Study. Outstanding Careers. Free Literature. **P.C.D.I.**, Atlanta, Georgia. Call 800-362-7070. Dept. ELH342.

PLANS-KITS-SCHEMATICS

Awesome Kits: Voice Changers, Levitators, Lasers, Solar Robots and more! Catalog \$1.00. **LNS Technologies**, PO Box 67243, Scotts Valley, CA 95067 www.ncl.verio.com/~Lnstech

ELECTRONICS PROJECT KITS: \$3.00 catalog. 49 McMichael St. Kingston, ON, K7M 1M8. www.qkits.com - **QUALITY KITS**

SATELLITE EQUIPMENT

DSS Hacking: How to construct and program smart cards, with pic 16C84, software, Complete DSS system schematics, \$16.95. **CABLETRONICS**, Box 30502E Bethesda, MD 20824.

DSS Test card. Authorizes all channels for information, plus free bonus. Call toll free 1-888-416-7296.

FREE Satellite TV Buyer's Guide. Best Products - Lowest Prices - Fastest Service! Dish Network, DirecTV, C/Ku-band, including 4DTV. Parts - Upgrades - Accessories! **SKYVISION** - 800-543-3025. International 218-739-5231 www.skyvision.com

TEST EQUIPMENT

Large assortment of used test equipment for sale. Request catalog or visit our website. **Stevenson Equipment Company** 609-888-2846 Fax: 609-888-2847 <http://www.stevensonlabs.com>

Test Equipment Sale! Complete listing at <http://www.astglobal.com> or call **NOW** to receive list by fax or mail. **AST GLOBAL ELECTRONICS**: Voice 888-216-7159, Fax 814-398-1776; e-mail: sales@astglobal.com

WANTED

WANTED: USED TEST EQUIPMENT. TURN IDLE OR EXCESS EQUIPMENT INTO CASH. **AST GLOBAL ELECTRONICS**: Voice 888-216-7159; Fax 814-398-1176; e-mail: sales@astglobal.com

RETAILERS THAT SELL OUR MAGAZINE EVERY MONTH

Arizona

Circuit Specialists, Inc.
220 S. Country Club Dr.
Bldg 2
Mesa, AZ 85210

California

California Electronics
221 N. Johnson Ave.
El Cajon, CA 90202

Ford Electronics
8431 Commonwealth Ave
Buena Park, CA 90621

All Electronics
14928 Oxnard Street
Van Nuys, CA 91411

Mac's Electronics
191 South "E" Street
San Bernardino, CA 92401

Electronics Warehouse
2691 Main Street
Riverside, CA 92501

Orvac Electronics
1645 E Orangethorpe Ave.
Fullerton, CA 92631

Sav-On Electronics
13225 Harbor Blvd.
Garden Grove, CA 92643

JK Electronics
6395 Westminster Blvd.
Westminster, CA 92683

Kandarian Electronics
1101 19th Street
Bakersfield, CA 93301

Minute Man Electronics
37111 Post St., Suite 1
Fremont, CA 94536

HCS Electronics
6819 S. Redwood Drive
Cotati, CA 94931

Halted Specialties Co.
3500 Ryder Street
Santa Clara, CA 95051

Metro Electronics
1831 J Street
Sacramento, CA 95814

HSC Electronics
4837 Amber Lane
Sacramento, CA 95841

Colorado

Centennial Electronics
2324 E. Bijou
Colorado Spgs., CO 80909

Connecticut

Cables & Connectors
2198 Berlin Turnpike
Newington, CT 06111

Electronic Service Prod.
437 Washington Avenue
North Haven, CT 06473

Georgia

Normans Electronics Inc.
3653 Clairmont Road
Chamblee, GA 30341

Illinois

Tri State Elex
200 W. Northwest Hwy.
Mt. Prospect, IL 60056

Indiana

Black Cat
566 S. Main Street
North Webster, IN 46555

Maryland

Mark Elec. Supply Inc.
5015 Herzl Place
Beltsville, MD 20705

Massachusetts

U-Do-It Electronics
40 Franklin Street
Needham, MA 02194

Michigan

Purchase Radio Supply
327 East Hoover Avenue
Ann Arbor, MI 48104

Norwest Electronics
33760 Plymouth Rd.
Livonia, MI 48150

The Elec. Connection
37387 Ford Road
Westland, MI 48185

Minnesota

Acme Electronics
224 Washington Avenue N.
Minneapolis, MN 55401

New Jersey

Lashen Electronics Inc.
21 Broadway
Denville, NJ 07834

New York

LNL Distributing Corp.
235 Robbins Lane
Syosset, NY 11791

Unicorn Electronics
Valley Plaza
Johnson City, NY 13790

Ohio

Philcap Electronic Suppliers
275 E. Market Street
Akron, OH 44308

Oregon

Norvac Electronics
7940 SW Nimbus Avenue
Beaverton, OR 97005

Texas

Tanner Electronics
1301 W Beltline
Carrollton, TX 75006

Mouser Electronics
958 N. Main Street
Mansfield, TX 76063

Electronic Parts Outlet
3753 B Fondren
Houston, TX 77063

Computers Electronics Etc.
110 E. Medical Center Blvd.
Webster, TX 77598

If you'd like to sell our magazine in your store,
please circle 210 on free information card
or

Contact Christina Estrada at (516) 293-3000 ext 223

How To Succeed In Soldering

Using the right soldering tools along with tried and proven techniques are the keys to getting great solder joints every time.

SKIP CAMPISI, JR.

With proper techniques and just basic equipment, an individual should be able to achieve a perfect solder joint each and every time. What's more, that joint should be formed in about three to four seconds after applying the iron. That said, many fail to achieve this ideal, even with expensive gear and hours of practice. If that describes you, don't despair—help is on the way!

By now I'm sure you'll all be asking, "Who does this guy think he is, trying to tell ME how to solder?" A fair question, to which I can give a fair answer: I have been an electronics hobbyist for over thirty-five years and have used most types of soldering systems at one time or another. This includes about twenty-five years as an electronics professional.

What I'll be describing in this article is based on my past experience with soldering: how to select the correct tools and solder, and techniques to use that guarantee success. Note that a lot of what follows goes against the "book" or conventional wisdom, so if you are already successful and happy with your own soldering methods—and they work well—don't change them! However, for those who aren't happy, this is for you.

Getting Hot Over Heat. The first thing we need for a good joint is HEAT, and plenty of it, to achieve a quick joint. For standard through-hole circuit boards I use only one

iron: a soldering pencil with a 33-watt element running "flat-out" with no control (except for demanding jobs, I've found that temperature-controlled irons are often more trouble than they are worth). The tip is a standard $\frac{1}{8}$ -inch chisel style.

I can hear you all grumbling already: "Too much heat! You'll destroy your components!" This is not true at all. The secret lies in the tip: use only iron-clad soldering tips and keep them well tinned throughout the job. Mine always last for at least a year, and I do a lot of soldering!

So, how about surface-mount devices? I still use the same heat element, this time with a $\frac{1}{16}$ -inch or smaller chisel tip. I know, still too much heat! In some cases, this can be true; however, judicious use of heat sinks on component leads is 100% effective. I'm definitely NOT talking about "grasping the lead with needle-nose pliers," as is so often mentioned in soldering tutorials. Have you ever tried that method? Whew!

In my experience, standard, "micro-gator" clips are extremely effective as heat sinks on components or component leads. Those are the clips that have flat jaws as opposed to the serrated jaws found in alligator clips. Sensitive devices such as precision resistors, capacitors, and of course all semiconductors can be soldered without damage using micro-gator clips, which are available from

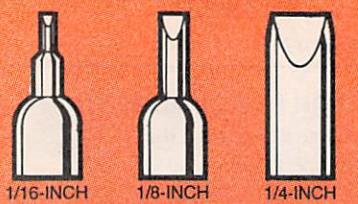


many sources including RadioShack. For tiny SMD transistor packages and the like, a clip snapped right onto the package itself is quite effective.

Your next question might be: "What element should I use for heavier joints, such as those involving wires and terminals?" Again, the 33-watt element is perfect for wires up to about 14 gauge, using the $\frac{1}{8}$ -inch chisel tip. For really heavy work, I switch to a 47-watt element with a $\frac{1}{4}$ -inch tip for faster heat transfer.

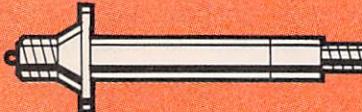
Heat transfer is the number-one factor for successful solder joints. The faster it is accomplished (within reason!), the better your joints will be. Period. More components are damaged by applying lower-heat irons to joints for long time periods, as opposed to higher heat irons for the three or four seconds mentioned previously. And, of course, use of a soldering gun is definitely overkill! I don't even own a gun.

Solder. So then, what's the best all-around solder to use? The absolute BEST solder I've ever used is: KESTER "44" resin-core solder, with their #66 core. For general circuit-board soldering, I use their 60/40 alloy in 0.031-inch ($\frac{1}{32}$ -inch) diameter. For SMT soldering, I switch to 0.015-inch or 0.020-inch diameter. Note, there may well be equivalent solder out there by another manufacturer, but this is what works for me so I stopped looking.

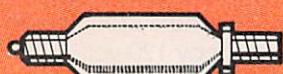


A

33W (METAL)



33W (CERAMIC)



B

Typical chisel tips shown here (A) are used for SMT, general work, and heavy-duty work. They should all be of the "iron-clad" variety and threaded to fit the correct heat element. The heat elements shown (B) are made in two styles: metal cased or ceramic cased. Both thread right into a handle, with a "cool-grip" handle being the best choice.

The reason I consider this solder to be the best is due to the resin core itself. This is one brand of flux that you do NOT have to remove from your finished circuit board! Honest! I have many projects from over twenty years ago that are still functioning 100% correctly despite the fact that the boards are still "swimming" in the original flux residue. No type of corrosion or other type of damage was ever found in those units due to flux residue.

So, what's the big deal about de-fluxing a board? Well, if you've ever tried to de-flux a board, you already know what a messy job that can be. No matter what you do, all that you'll end up with is diluted flux residue spread over the entire board and its components. You can readily feel that as a sticky residue on everything. Erratic component and board functioning is often the direct result of this mess.

While hobbyists try to do it anyway, the proper method of de-fluxing boards is just not practical for the average hobbyist. To do it right requires industrial-strength flux-removing chemicals, a hot-soap

ultrasonic cleaning, a thorough water rinse, some time baking in an oven to dry the board, and finally applying a chemical sealant to the finished board to prevent further contamination. If you can't do all of this, de-fluxing a board is just a waste of time. So, a flux that is inactive at normal ambient temperatures is obviously quite desirable.

Of course, there are situations where leaving even an inactive flux on the board could cause problems, such as when dealing with sensitive nodes at very low current levels where leakage through flux paths can be greater than the signals. The trick in those situations is to create an air-gap or use a Teflon-insulated standoff terminal to keep the joint off of the surface of the board. This is 100% effective.

Speed Does Not Kill. So, now we know what solder and iron to use, what's the REAL trick to making a "quick" joint? This is where you have to develop the proper techniques in using a "hot" iron. That will take some practice to really get up to speed, especially if you've already developed some bad soldering habits.

Tip maintenance is extremely important when using a "hot" iron with an iron-clad tip. As already mentioned, the tip must be kept tinned at all times for protection of its surface. When first using a new tip, allow it to heat up while attempting to tin it every few seconds with the proper solder until you achieve a complete coating. DON'T allow the tip to overheat without any tinning to protect it!

Once you have it completely tinned, shake off the excess solder with a quick flip of your wrist. I keep a standard "paper plate" on the floor next to my bench to catch the solder splats. After a few more seconds, apply more solder to the tip, shaking off the excess once again. Repeat until you're satisfied with the tinning job. (After completing your soldering job, re-tin the entire tip again before removing power from the iron.)

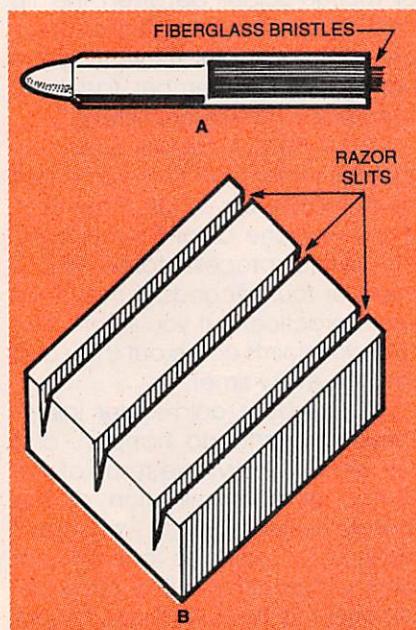
Before applying the tip to any joint, it has to be wiped properly to expose fresh, un-oxidized solder. The best method of doing this is to use

a damp sponge. Obtain a standard soldering sponge and before applying water to it, use a razor blade or hobby knife to slit it lengthwise. Cut in about three or four slits without cutting through the sponge material, going down about only half-way through its thickness.

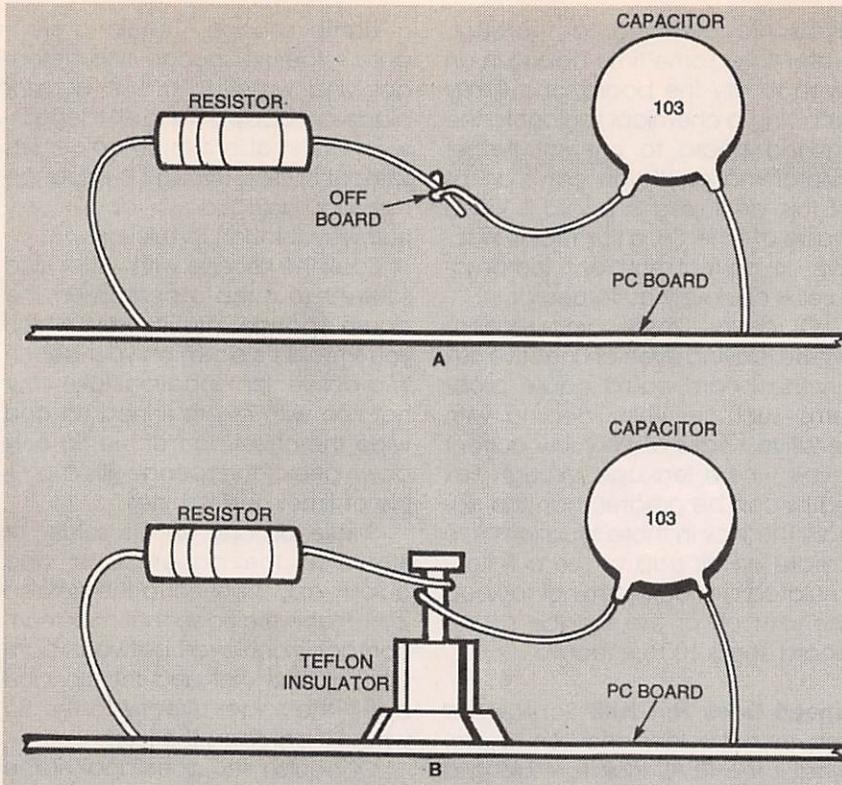
Soak the sponge with water, and squeeze out the excess. Insert the damp sponge into its tray, which you should tie down on your bench in a convenient location. Take your hot iron with its pre-tinned tip and wipe the chisel part of the tip only down one of the sponge slits a couple of times until it shines.

Shake off any excess solder or flux onto the paper plate, and quickly apply the tip to the desired joint. Place the tip so that maximum contact is achieved between both parts of the joint and the tip, and apply the solder directly to the tip where it contacts the joint.

Of course, this goes against the textbook techniques that say to apply the solder to the joint, never to the tip of the iron! Well, that's perfectly fine, if you don't mind cooking everything while waiting for the solder to melt. As I've already stated, I'm showing you



A fiberglass eraser (A) is excellent for removing tarnish and rust. Note the brush full of fiberglass bristles which can be retracted when not in use. The sponge block (B) illustrates the slits made with a razor blade to facilitate proper cleaning of the chisel section of the tip.



To avoid signal leakage through flux residue on the PC board, create an air gap between the joint and the board as shown in A or use a Teflon-insulated terminal as shown in B.

how to make a perfect joint quickly, without damaging anything. By applying the solder directly to the tip where it contacts the joint, it immediately melts, forming a pool of molten solder between the tip and joint. That allows additional solder to flow by quickly wetting the entire joint. (Remember fast heat transfer is what we are after.)

Once that happens, you can shift the solder feed to the joint itself for complete coverage if needed. If you've done all of this correctly, the entire process takes about three or four seconds. It may take some practice, but you'll note that all of your joints come out shiny and smooth, every time!

What about cold-solder joints? These can and do happen, and are almost always the result of oxidation or contamination of the metals in the joint. If you can't achieve a "wet" on a particular joint within about five seconds, remove the heat and select your favorite solder removing tool. I prefer a large, vacuum-type "solder-sucker" over solder-wicking materials. Re-tin the chisel tip, apply it to the joint, and remove the solder you first put on the joint. Be careful

not to overheat the joint in this step!

Now take a standard, fiberglass "eraser" (found in office supply stores or at RadioShack) and use it to scrub the entire metal surface of the joint area. The fiberglass "brush" of the eraser does an excellent job in polishing the joint. It is also useful in removing rust from any ferrous materials. Now you may proceed to re-solder the joint; it should wet easily. By the way, it's a wise idea to polish any suspect metal with the eraser before attempting to apply solder; darkened areas of tarnish on switch contacts and some component leads are easily spotted beforehand.

So, there you have it: the quick and perfect solder joint. Sounds easy enough, doesn't it? I know a lot of you out there probably won't agree with my methods, but they DO work well! Why not fire up your old pencil iron and give it a shot. With a little practice, you too can make that perfect joint in under five seconds.

SAFE CROSSWALK

(continued from page 48)

FOR MORE INFORMATION

LightGuard Systems, Inc.
2292 Airport Blvd.
Santa Rosa, CA 95403
Tel: 707-542-4547
Web: www.crosswalks.com

people at night have reported that they simply did not see them in time.

Where, and How Much? All components of the system operate on 12-volts DC. The system could also be powered by 120-volt AC or by a stand-alone solar-powered battery system where electric power is not available. The units require little energy to operate—about as much a 20-watt light bulb.

According to LightGuard System, Inc., the system's cost is significantly less than a typical traffic-signal installation. Depending on the installation, selling prices range from \$10,000 to \$20,000.



To activate the system in a typical setup, pedestrians simply walk between two Bollards at the top of the crosswalk.

Currently, LightGuard Systems have been installed in Lafayette, Orinda, Petaluma, and Santa Rosa in California as well as in Florida, Nevada and Washington. Six solar-powered units are in operation in Saipan in the Mariana Islands. As of now, the LED signal heads project about 1/2-inch above the pavement surface, which could present problems for snowplows (though rubber-tipped plow blades could help here), but LGS plans to introduce a version that is more snowplow friendly. The system is also installed at the Reno-Tahoe International Airport.



EIS Impedance Spectroscopy, New Current Sensors, and More

THIS MONTH, WE MIGHT LOOK AT AN ARCANAE NEW FIELD KNOWN AS EIS (ELECTROCHEMICAL IMPEDANCE SPECTROSCOPY), WHICH JUST MIGHT LEAD TO A FEW FASCINATING PAPERS AND LOTS OF EXCIT-

ing opportunities. But before we do, perhaps we should once again go over...

Frequency and Spectra

Say you are in an orchard during a windstorm. You happen to notice that 240 apples per minute are falling on the average. From the dictionary definition, we could say the frequency of apple falling is four apples per second, or that the time period between apple fallings averages 0.25 seconds.

Electronic frequency has a rather more precise definition, but one that usually leads us to the same concept. Suppose you have a voltage on some terminal. Only one voltage is there at any given time, even though that one voltage might be the sum of a few wanted signals mixed with unwanted distortion or noise. You call the instantaneous voltage there a phase, and then can specially define frequency as being the rate of change of phase.

Often, the rate of change of phase will include identifiable components that look like one or more sinewaves. You can tell how large a sinewave is by its amplitude and how fast it is going by its frequency. The usual way to show this is:

$$e = A \sin(\omega t)$$

where A is the peak amplitude of your sinewave and ω is its radian frequency. (Radian frequency comes about because

there are 2π or 6.2830 radians that run around a sine-cosine circle. For instance, 60 hertz has a radian frequency of 377.)

Things become further complicated

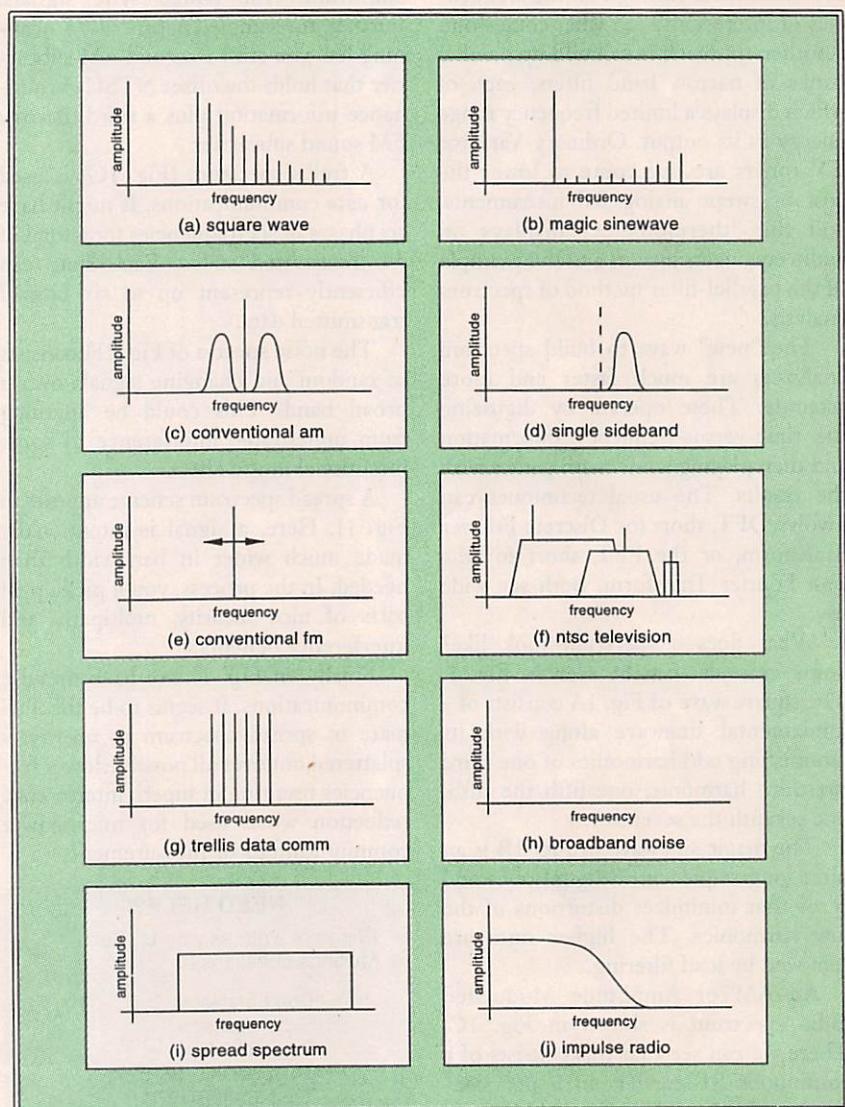


FIG. 1—SOME EXAMPLES of frequency spectra.

if they are changing. It is convenient to separate out the transient and steady-state conditions. Transients (such as when starting up) often may involve exponentials, while steady state tends towards sinewaves.

Frequencies of technical interest range as low as the few hertz found in earthquakes and brainwaves; up through audio, radio, microwaves, and the exotic terahertz mystery band; through heat, light, and ultraviolet; and on up to high-energy particles. The arrangement of all frequencies expected to be present is often called a spectrum. A spectrum is normally shown as a plot of amplitude versus frequency. An instrument to display a spectrum is often called, of all things, a spectrum analyzer.

The "old" techniques for building spectrum analyzers are to sweep a narrow band filter through all the frequencies of interest and see what comes out. Another approach is to build up parallel banks of narrow band filters, each of which displays a limited frequency range energy as its output. Ordinary Varactor TV tuners are one route to lower the cost of swept analog RF instruments, and the "thermometer" displays on audio equalizers give us a useful example of the parallel-filter method of spectrum analysis.

The "new" ways to build spectrum analyzers are much faster and more accurate. These operate by digitizing the time-versus-frequency information and then playing a few math games with the results. The usual techniques can involve DFT, short for Discrete Fourier Transform, or the FFT, short for the Fast Fourier Transform. Both see wide use.

What does a spectrum look like? Some examples can be seen in Fig. 1. The square wave of Fig. 1A consists of a fundamental sinewave along with its diminishing odd harmonics of one third the third harmonic, one fifth the fifth, one seventh the seventh...

The magic sinewave of Fig. 1B is an ultra-long sequence of digital ones and zeros that minimizes distortions of the low harmonics. The higher ones are removed by load filtering.

An AM or Amplitude Modulated radio spectrum is shown in Fig. 1C. There we can see that this consists of a continuous RF carrier, an upper sideband, and a lower sideband. AM is not efficient because the carrier conveys no useful information and the upper and

lower sidebands are nearly identical.

The single sideband spectrum of Fig. 1D transmits only the chosen upper or lower sideband of an AM signal. It is more efficient in both bandwidth and power. But elaborate techniques are needed at the receiver to mimic the needed carrier for detection.

A frequency modulation spectrum (Fig. 1E) results when some carrier's frequency is moved back and forth. Rather than up and down in strength as in AM, FM communication gives you strong noise reduction because signals can be hard limited. The math behind FM signals gets nasty and often involves Bessel Function beasties.

The television spectrum of Fig. 1F is more complex. It is mainly AM, but the lower vestigial sideband is limited to lower frequencies, which allow stronger amplitudes for fringe sync signals. Further, the sampled nature of TV scanning lets you stuff a second AM subcarrier that holds the offset NTSC chrominance information plus a third, narrow FM sound subcarrier.

A trellis spectrum (Fig. 1G) is used for data communications. It might have six phases of six frequencies for a total of 64 transmitted states. Each state can efficiently represent up to six bits of transmitted data.

The noise spectra of Fig. 1H consists of random and changing signals over a broad band. This could be anything from undesirable interference to some intentional music effect.

A spread spectrum scheme appears in Fig. 1I. Here, a signal is intentionally made much wider in bandwidth than needed. In the process, you'll pick up all sorts of nice security, multipath, and interference benefits.

Finally, in Fig. 1J, we have impulse communications. It seems to be the ultimate in spread spectrum as energy is splattered out over all possible lower frequencies resulting in superb interference reduction when used for micropower communications or measurement.

NEED HELP?

Phone or write all your US Tech Musings questions to:

Don Lancaster
Synergetics
Box 809-EN
Thatcher AZ, 85552
Tel: 520-428-4073

US email: don@tinaja.com
Web page: <http://www.tinaja.com>

new from DON LANCASTER

ACTIVE FILTER COOKBOOK

The sixteenth (1) printing of Don's book on analog op-amp lowpass, bandpass, and highpass active filters. De-mystified instant designs. \$28.50

RESEARCH INFOPACKS

Don's instant cash-and-carry flat rate consulting service. Ask any reasonable technical question for a detailed analysis and complete report. See www.tinaja.com/info01 for specifics. \$79.00

CMOS AND TTL COOKBOOKS

Millions of copies in print worldwide. THE two books for digital integrated circuit fundamentals. About as hands-on as you can get. \$28.50 each.

INCREDIBLE SECRET MONEY MACHINE II

Updated 2nd edition of Don's classic on setting up your own technical or craft venture. \$18.50

LANCASTER CLASSICS LIBRARY

Don's best early stuff at a bargain price. Includes the CMOS Cookbook, The TTL Cookbook, Active Filter Cookbook, PostScript video, Case Against Patents, Incredible Secret Money Machine II, and Hardware Hacker II reprints. \$119.50

LOTS OF OTHER GOODIES

Tech Musings V or VI	\$24.50
Ask the Guru I or II or III	\$24.50
Hardware Hacker II, III or IV	\$24.50
Micro Cookbook I	\$19.50
PostScript Beginner Stuff	\$29.50
PostScript Show and Tell	\$29.50
PostScript Video & secrets	\$29.50
PostScript Reference II	\$34.50
PostScript Tutorial/Cookbook	\$22.50
PostScript by Example	\$32.50
Understanding PS Programming	\$29.50
PostScript: A Visual Approach	\$22.50
PostScript Program Design	\$24.50
Thinking in PostScript	\$22.50
LaserWriter Reference	\$19.50
Type 1 Font Format	\$16.50
Acrobat Reference	\$24.50
Whole works (all PostScript)	\$380.00
Technical Insider Secrets	FREE

BOOK-ON-DEMAND PUB KIT

Ongoing details on Book-on-demand publishing, a new method of producing books only when and as ordered. Reprints, sources, samples. \$39.50

THE CASE AGAINST PATENTS

For most individuals, patents are virtually certain to result in a net loss of sanity, energy, time, and money. This reprint set shows you Don's tested and proven real-world alternatives. \$25.00

Don's best early stuff at a bargain price. Includes the CMOS Cookbook, The TTL Cookbook, Active Filter Cookbook, PostScript video, Case Against Patents, Incredible Secret Money Machine II, and Hardware Hacker II reprints. \$119.50

LOTS OF OTHER GOODIES

Tech Musings V or VI	\$24.50
Ask the Guru I or II or III	\$24.50
Hardware Hacker II, III or IV	\$24.50
Micro Cookbook I	\$19.50
PostScript Beginner Stuff	\$29.50
PostScript Show and Tell	\$29.50
PostScript Video & secrets	\$29.50
PostScript Reference II	\$34.50
PostScript Tutorial/Cookbook	\$22.50
PostScript by Example	\$32.50
Understanding PS Programming	\$29.50
PostScript: A Visual Approach	\$22.50
PostScript Program Design	\$24.50
Thinking in PostScript	\$22.50
LaserWriter Reference	\$19.50
Type 1 Font Format	\$16.50
Acrobat Reference	\$24.50
Whole works (all PostScript)	\$380.00
Technical Insider Secrets	FREE

BOOK-ON-DEMAND PUB KIT

Ongoing details on Book-on-demand publishing, a new method of producing books only when and as ordered. Reprints, sources, samples. \$39.50

THE CASE AGAINST PATENTS

For most individuals, patents are virtually certain to result in a net loss of sanity, energy, time, and money. This reprint set shows you Don's tested and proven real-world alternatives. \$25.00

BLATANT OPPORTUNIST I

The reprints from all Don's *Midnight Engineering* columns. Includes a broad range of real world, proven coverage on small scale technical startup ventures. Stuff you can use right now. \$24.50

RESOURCE BIN I

A complete collection of all Don's *Nuts & Volts* columns to date, including a new index and his master names and numbers list. \$24.50

FREE SAMPLES

Check Don's Guru's Lair at <http://www.tinaja.com> for interactive catalogs and online samples of Don's unique products. Searchable reprints and reference resources, too. Tech help, hot links to cool sites, consultants, email: don@tinaja.com FREE US VOICE HELPLINE VISA/MC

SYNERGETICS

Box 809-EN
Thatcher, AZ 85552
(520) 428-4073

FREE catalog: <http://www.tinaja.com>

More on these topics appears in www.tinaja.com/muse01.html on my Guru's Lair Web site. Specific details on magic sinewaves are found in the Magic Sinewaves tech library located there as well. Additional filtering details are in my Active Filter Cookbook. We recently looked at impulse communications, and a new Web page on this is now in the works. *Spread Spectrum Scene* is a useful trade journal on this subject.

Electrochemical Impedance Spectroscopy

EIS is pretty much the opposite of spectrum analysis. Instead of seeing what frequencies are present, you'll purposely apply test frequencies to determine useful properties of some ionic liquid.

At any given frequency, a liquid or another substance has a resistive loss plus a reactive storage. More often than not, the storage component will be capacitive rather than inductive.

The losses of a substance tend to go up sharply with frequency, while the overall impedance decreases. Thus, EIS applies "by-frequency" measurement techniques to various electrochemical solids and liquids.

Important EIS uses include:

- corrosion prevention
- materials research
- cancer therapy
- paint development
- concrete testing
- battery monitoring

Finding an exact charge state and remaining lifetime for a battery can be extremely useful. In its spare time, EIS utterly demolishes the outrageous overstatement claims of the hydrogen "pulse electrolysis" crowd.

Figure 2 shows us a general impedance measurement scheme. Here, you apply a single frequency of known amplitude through a variable resistor and capacitor. That frequency goes into a sample of the measured substance. The sample has to be of a fixed and known size, geometry, pressure, and working temperature. You then adjust the variable resistor and variable capacitor so that the terminal voltage "B" will be one half of the input voltage ("A") and that the phase shift is exactly zero. When your sample is inductive, you'll use an input inductor instead.

This same concept, of course, is used

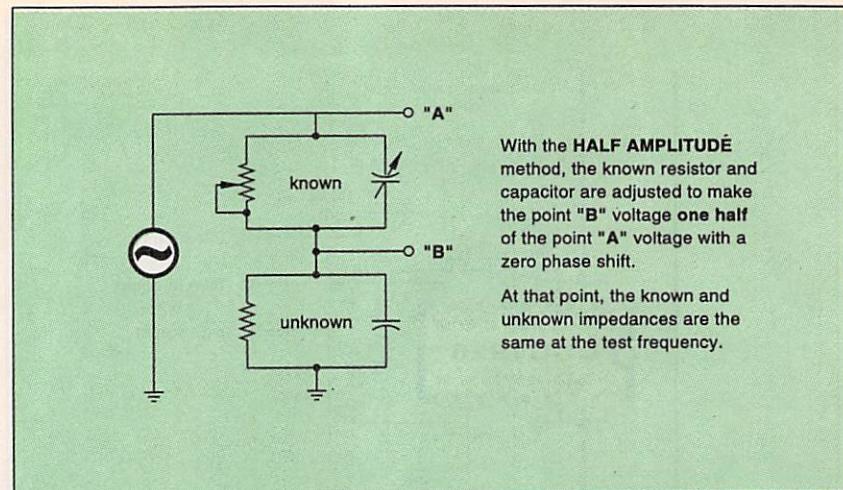


FIG. 2—MEASURING THE IMPEDANCE at a single frequency.

in compensating 10 \times oscilloscope probes. If the trimming cap is too small, the risetimes will be slow; too large and they overshoot.

There are many bridge variations of this circuit. These are often more concerned with finding component values instead of determining how the values vary with frequency. With EIS, the frequency variations are not at all obvious.

In Fig. 3 we see another and improved approach. Here we place the sample in the feedback path of an operational amplifier. By stepping or sweeping input frequencies, an EIS curve of impedance versus frequency can be determined. A big advantage here is lower impedance drive to your cell. Through suitable electrode design, nondestructive and real-time testing can easily be handled.

That feedback resistor is usually in the high megohms. Its value is much higher than the normally expected EIS resistance and can be ignored or adjust-

ed for. Circuit variations can simply measure the output amplitude and phase, or might continuously force a null balance.

At that point, the known and unknown impedances are the same at the test frequency.

By very careful evaluation of the EIS impedance versus frequency plot, the state of battery charge and life, the expected corrosion resistance of a coating, or even the status of a tumor treatment can be diagnosed.

EIS testing is both nondestructive and predictive. Test frequencies often go from tens of kHz on down to those ultra low frequencies used for battery charge-discharge cycles.

A summary of some EIS resources appears in the "Some EIS Resources" sidebar. The European studies and instruments appear to dominate this field. For more on EIS, enter "eis" and "electrochemical" in www.hotbot.com or into some other search engine, or use the convenient search buttons at my www.tinaja.com.

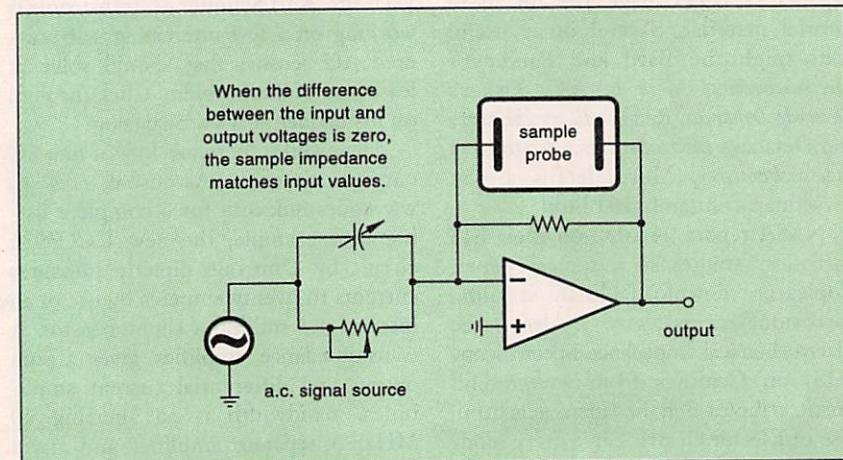


FIG. 3—AN IMPROVED METHOD of measuring impedance places the EIS cell in the feedback path of an operational amplifier.

Some EIS Resources

Researchers & Instrument Manufacturers:

ACM Instruments

125 Station Road
Clark Grange, LA11 7NY, UK
(44) 15395 59185

Gamry Instruments

734 Louis Drive
Warminster, PA 18974
(215) 682-9330

ISEA

Jagerstr 17/19
D-52066 Aachen GE
(49) 0-214-80-6920

Northwestern ITI

1801 Maple Avenue
Evanston, IL 60201
(847) 491-8165

Solartron

Victoria Road
Farnborough, Hampshire,
GU14 7PW, UK
(1) 610-2645034

TNO Tech Institute

1780 AB Den Helder
Netherlands
(31) 223-630867

Journals:

CA Selects: Analytical Electrochemistry
CA Selects: Electrochemical Reactions
Corrosion Science
Journal of Electroanalytical Chemistry
Journal of the Electrochemical Society
Journal of Solid State Electrochemistry
Surface Engineering and Applied
Electrochemistry

Books:

Electrochemical Methods (Rossiter & Hamilton)
Electrochemical Methods (Bard & Faulkner)
Impedance Spectroscopy (Ross MacDonald)
New Instrumental Methods in Electrochemistry (Paul Delahay)

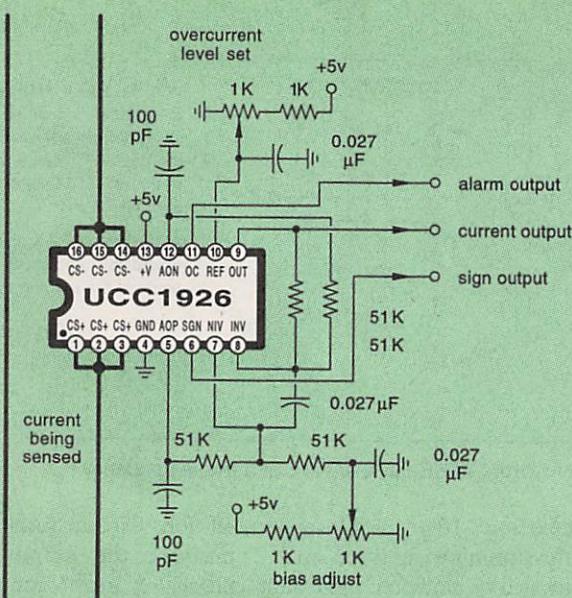


FIG. 4—THIS NEW CURRENT SENSOR has an internal shunt that is useful to 20 amperes. While ideal for AC power uses, the sensed frequencies can go as high as 40 MHz with suitable circuit variations.

The three leading manufacturers are Gamry Instruments, Solartron, and ACM Instruments. Solartron has just announced a new model 1275 EIS instrument. Additional details are at www.uniscan.co.uk/pr02.htm.

A good introduction to EIS can be found at www.bath.ac.uk/~chsacf/solartron/electro/html/int.htm. Topics here include electrode kinetics, mass transport, cyclic voltammetry, and double layer effects.

A good book on the topic is *Macdonald's Impedance Spectroscopy*. See the *Electrochemical Society Proceedings*, Vol. 95-21, 1995, page 103 for more tutorial material. Several other useful texts might be Bard and Faulkner's *Electro-chemical Methods*, A.C. Fisher's *Electrode Dynamics*, Reiger's *Electrochemistry* and Delahays *Instrumentation Methods in Electrochemistry*. More details are at www.tinaja.com/amlink01.html.

NASA report 94-2082 on their EIS corrosion studies is a typical paper. Copies are downloadable by emailing corrosion@ksc.nasa.gov. Also see *Electrochemical Impedance Spectroscopy (EIS)* on Coatings from www.tno.nl/instit/kribc/ca-den_helder/caeis.html. Use of EIS for electric car-battery modeling appears at www.rwth-aachen.de/isea/Ww/texte/abstract/ka_vrl_a.htm. More details on this device are in Fig. 4.

A summer course on EIS and other electrochemical techniques is going to be offered by minerva.acc.virginia.edu/~cece/taylor/eisshort.html. Additional consulting on EIS and other technical topics is available by way of www.tinaja.com/info01.html

Some New Current Sensors

I still could use a few low cost and snap-on wireless AC current sensors as this is the key to intelligent home energy management. Details on this isopod concept can be found by a search on my Web site. Karl Schmidt of Transtronix is working on a few interesting self-powered AC sensors that should solve at least part of the problem. Click through on his banner at www.tinaja.com.

Meanwhile, there are lots of new IC current sensors. As usual, go to www.questlink.com for a complete listing. For example, the new UCC3926 circuit by Unitrode directly measures currents to twenty amperes by use of an internal 1.3 milliohm shunt resistor. A transimpedance amplifier gives a sign output and differential current amplitudes. Bandwidth is an amazing 40 MHz! A separate amplifier and alarm comparator is provided on the same chip. More details on this device are in Fig. 4.

The supply voltage can vary from just under 5 to 12 volts. Current sensing can be on the high side, low side, or anywhere else between. I've left the supply

Names And Numbers

Advanced Linear Devices

415 Tasman Dr.
Sunnyvale, CA 94089
(408) 747-1155

AEMC Instruments

99 Chauncy St.
Boston, MA 02111
(800) 343-1391

Amprobe

630 Merrick Rd.
Lynbrook, NY 11653
(516) 593-5600

Armour Products

PO Box 128
Wyckoff, NJ 07481
(201) 847-0404

Bull Electrical

250 Portland Rd.
Hove Sussex, BN3 5QT, UK
44 (0)1273 203500

International Association of Calculator Collectors

14561 Livingston St.
Tustin, CA 92780

Computer Aided Engineering

1100 Superior Ave.
Cleveland, OH 44114
(216) 696-7000

Fuel Cell Bulletin

Box 945
New York, NY 10159
(212) 633-7300

Home Power

PO Box 520
Ashland, OR 97520
(916) 475-3179

InfoStor

98 Spit Brook Rd.
Nashua, NH 03062
(603) 891-0123

IVR

12 West 21 Street
New York, NY 10010
(212) 691-8215

LND

3230 Lawson Blvd.
Oceanside, NY 11572
(516) 678-6141

Reliable Power Meters

400 Blossom Hill Rd.
Los Gatos, CA 95032
(408) 358-5100

Jake Schwartz

135 Saxby Terrace
Cherry Hill, NJ 08003
(609) 751-1310

Simtek

1465 Kelly Johnson Blvd.
Colorado Springs, CO 80920
(800) 637-1667

Spread Spectrum Scene

PO Box 2199
El Granada, CA 94018
(800) 524-9285

STMicroelectronics

55 Old Bedford Rd.
Lincoln, MA 01773
(781) 259-0300

Surplus Record

20 N Wacker Drive
Chicago, IL 60606
(312) 372-9077

Synergetics

Box 809
Thatcher, AZ 85552
(520) 428-4073

Trantronics

3209 W 9th St.
Lawrence, KS 66049
(785) 841-3089

Unitrode

7 Continental Blvd.
Merrimack, NH 03054
(603) 424-2410

Victoreen

6000 Cochran Rd.
Cleveland, OH 44139
(440) 248-9300

bypassing and some gain options off this simplified circuit, so be certain to read the Unitrode data sheet and any applications notes before actually putting this IC to use.

Another interesting but pricey new development is a flexible current transducer. Instead of a clamp-around "glomer," you've got this rope-shaped transducer that could be carefully worked

around individual wires in confined spaces.

An entire family of new AmpFlex flexible current probes is now being sold by AEMC Instruments. Their 30 models span from 0.5 to 30,000 amps and lengths of two to five feet. Typical list prices are \$300.

Amprobe sells an ACF-3000. This one gives you one millivolt per amp on their 300-amp range, and one tenth that on the 3000-amp range. Another example is the Flexi-CT model from Reliable Power Meters.

More on home energy management at *Home Power Magazine*. Bargains in older snap-on ammeter probes are at www.tinaja.com/barg01.html.

New Tech Lit

From Advanced Linear Devices, comes a data book on a group of electrically programmable analog devices. These replace trim pots and can ease system calibration.

From Simtek, there's a new data book on non-volatile RAM. Micrel is offering a new MIC502 fan management chip. From STM comes a one piece TDA7521 analog front end for use in CD applications. A useful tutorial on gas-discharge lamps is found at www.intermarket.net/~don/dschlamp.html.

Jake Schwartz has a two-CD set on Hewlett Packard Calculating History at \$23. Bunches of other useful information on old calculators can be found in the *Calculator Collector* newsletter from the International Association of Calculator Collectors.

Experimental fuel cells are offered by Bull Electrical. A very expensive but definitive *Fuel Cells Bulletin* is published by Elsevier Science.

Other featured trade journals for this month include *Computer Aided Engineering*, *IVR* (as in Interactive Voice Response), and *InfoStor*. The latter is a new tabloid on disk drives, data sharing, and archiving.

Surplus Record is a thick monthly list that has tens of thousands of used machine tools. It's now in its 75th year.

Glass and mirror etching tools and supplies are stocked in depth by the folks at Armour Products. One source for radiation-detector sensors is LND. They also resell Geiger tubes, ionization chambers, counters, and neutron detectors. Also try Victoreen Instruments.

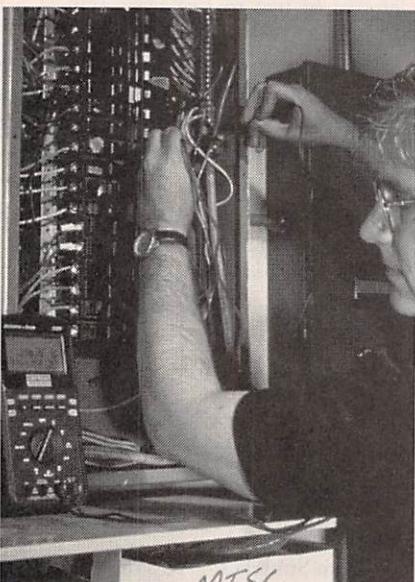
(Continued on page 95) 91

NEW PRODUCTS

(continued from page 27)

and alligator clips.

The Craftsman Professional Multimeter +



CIRCLE 25 ON FREE INFORMATION CARD

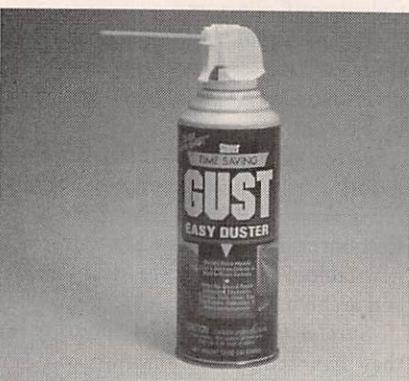
Scope (#82089) retails for \$299.99.

SEARS ROEBUCK, INC.

Tel: 800-390-8792 (information) or 800-377-7414 (sales)

Equipment Cleaner

THE GUST-AIR DUSTER EASILY removes dust and dirt from glass, computers, tools, plastics, rubber, or appli-



CIRCLE 26 ON FREE INFORMATION CARD

ances. Using a clean, filtered, moisture-free, high pressure propellant that is colorless, odorless, and non-ozone depleting, the cleaner won't scratch or harm delicate surfaces.

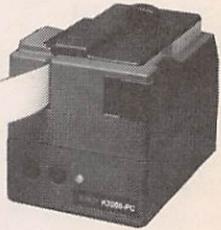
GUST can be used to repair person-

al computers, stereos, TVs, and VCRs that may be faulty due to dust build up. Additional uses include dusting cameras, camcorders, computer keyboards, and other home or office equipment, as well as removing sawdust and metal filings from saw, drills, and other tools. Each GUST Cleaning Kit includes three 15-ounce cans of GUST. The GUST Cleaning Kit sells factory direct for \$19.95 plus \$4.50 S&H.

STONER

1070 Robert Fulton Highway
P.O. Box 65
Quarryville, PA 17566
Tel: 888-STONERS
e-mail: STONER1@epix.net
Web: www.stonersolutions.com

compact K2000-PC label and bar-code printer connects to a personal computer and prints graphics, logos, bar codes, and data records onto a wide range of labels. The user can choose from economical direct-thermal labels, heavy-duty industrial labels that are heat and



CIRCLE 28 ON FREE INFORMATION CARD

S-Video Compensator



CIRCLE 27 ON FREE INFORMATION CARD

DESIGNED TO AMPLIFY AND correct S-video signal in all installations, the SA 201 Single Channel S-Video Compensator is a true S-video amplifier. The SA 201 provides one gold-plated S-video output with a dedicated set of controls (chroma gain, luminance gain, and a cable compensation control knob) allowing precise, customized calibration.

The SA 201 is compatible with S-video signals in NTSC, PAL, and SECAM standards. Setup and installation require one- to two-meter S-video cable lengths from the S-video output to the S-video in. The SA 201, housed in a compact, aluminum case, is powered by a 16-volt AC transformer. The SA 201 has a suggested retail price of \$300.

TRIBUTARIES

1307 East Landstreet Road
Orlando, FL 32824-7926
Tel: 800-521-1596
Web: www.tributariescable.com

PC-Label Printer

Merging the latest labeling technology with the ease of personal computing, the

chemical resistant, tamper-evident stock that alerts the user if the label has been tampered with, shrink tubing to mark wires or cables, and general-purpose or die-cut labels in a variety of sizes. Supplies are easily changed by simply dropping in a new cartridge.

The K2000-PC printer comes with easy-to-use software so it's simple to create, edit, and save a variety of labels. Compatibility with most Windows software allows the user the time-saving option of updating and printing labels from data already entered into programs like Microsoft Word or Excel. The K-2000-PC label printer has a suggested retail price of \$199.

KROY LLC

7550 East Red Field
Scottsdale, AZ 85260-3443
Tel: 800-733-5769 or 602-948-2222
e-mail: info@kroy.com
Web: www.kroy.com

EN



Budget Project and Computer Books

BP317—Practical Electronic Timing \$6.99. Time measurement projects are among the most constructed gadgets by hobbyists. This book provides the theory and backs it with a wide range of practical construction projects. Each project has how-it-works theory and how to check it for correct operation.

BP415—Using Netscape on the Internet \$8.99. Get with the Internet and with surfing, or browsing, the World Wide Web, and with the Netscape Navigator in particular. The book explains: The Internet and how the World Wide Web fits into the general scenario; how do you go about getting an Internet connection of your own; how to download and install the various versions of Netscape browsing software that are available; and how to use Netscape Navigator to surf the Web, and to find and maintain lists of useful sites. There's a heck of a lot more, too!

BP325—A Concise User's Guide to Windows 3.1 \$6.99. Now you can manage Microsoft's Windows with confidence. Understand what hardware specification you need to run Windows 3.1 successfully, and how to install, customize, fine-tune and optimize your system. Then you'll get into understanding the Program Manager, File Manager and Print Manager. Next follows tips on the word processor, plus how to use Paintbrush. There's more on the Cardfile database with its auto-dial feature, Windows Calendar, Terminal, Notepad, etc.

BP327—DOS: One Step at a Time \$5.99. Although you spend most of your time working with a word processor, spreadsheet or database, and are probably quite happy using its file management facilities, there will be times when you absolutely need to use DOS to carry out 'house-keeping' functions. The book starts with an overview of DOS, and later chapters cover the commands for handling disks, directories and files.

PCP119—Electronic Music and Midi Projects \$12.95. Save cash by building the MIDI gadgets you need. Want a MIDI THRU box, program change pedal, Metronome, analog echo unit, MIDI patchbay or switcher? Over 16 practical and very useful music and MIDI projects—all in this book! The projects are explained in detail with full instructions on assembly.

PCP120—Multimedia on the PC! \$14.95. What is Multimedia? What can it do for you? It can do lots of nice things! This 184-page book helps you create your own multimedia presentation. Multimedia applications by people like you can revolutionize educational and business applications as well bring more fun, fun, fun into your leisure computer activities.

BP404—How To Create Pages for the Web Using HTML \$7.99. Companies around the world, as well as PC users, are fast becoming aware of the World Wide Web as a means of publishing information over the Internet. HTML is the language used to create documents for Web browsers such as Mosaic, Net-scape and the Internet Explorer. These programs recognize this language as the method used to format the text, insert images, create hypertext and fill-in forms. HTML is easy to learn and use. This book explains the main features of the language and suggests some principles of style and design. Within a few hours, you can create a personal Home Page, research paper, company profile, questionnaire, etc., for world-wide publication on the Web.



BP377—Practical Electronic Control Projects \$7.99. Electronic control theory is presented in simple, non-mathematical terms and is illustrated by many practical projects suitable for the student or hobbyist to build. Discover how to use sensors as an input to the control system, and how to provide output to lamps, heaters, solenoids, relays and motors. Also the text reveals how to use control circuits to link input to output including signal processing, control loops, and feedback. Computer-based control is explained by practical examples.

BP411—A Practical Introduction to Surface Mount Devices \$6.99. This book takes you from the simplest possible starting point to a high level of competence in working with Surface Mount Devices (SMD's). Surface mount hobby-type construction is ideal for constructing small projects. Subjects such as PCB design, chip control, soldering techniques and specialist tools for SMD are fully explained. Some useful constructional projects are included.

BP136—25 Simple Indoor and Window Aerials \$2.99. Many people live in flats and apartments where outdoor antennas are prohibited. This does not mean you have to forgo shortwave listening, for even a 20-foot length of wire stretched out under a rug in a room can produce acceptable results. However, with experimentation and some tips, you may well be able to improve further your radio's reception. Included are 25 indoor and window antennas that are proven performers. Much information is also given on shortwave bands, antenna directivity, time zones, dimensions, etc. A must book for all amateur radio enthusiasts.

BP379—30 Simple IC Terminal Block Projects \$6.99. Here are 30 easy-to-build IC projects almost anyone can build. Requiring an IC and a few additional components, the book's 'black-box' building technique enables and encourages the constructor to progress to more advanced projects. Some of which are: timer projects, op-amp projects, counter projects, NAND-gate projects, and more.

BP401—Transistor Data Tables \$7.99. The tables in this book contain information about the package shape, pin connections and basic electrical data for each of the many thousands of transistors listed. The data includes maximum reverse voltage, forward current and power dissipation, current gain and forward transadmittance and resistance, cut-off frequency and details of applications.

ETT1—Wireless & Electrical Cyclopedia \$4.99. Step back to the 1920's with this reprinted catalog from the Electro Importing Company. Antiquity displayed on every page with items priced as low as 3 cents. Product descriptions include: Radio components, kits, motors and dynamos, Leyden jars, hot-wire meters, carbon mikes and more. The perfect gift for a radio antique collector.

BP93—Electronic Timer Projects \$2.99. This book covers many of the possible applications of timer circuits. These circuits may turn on or off at either some preset time or after an elapsed time. Some of the more complicated timer and clock circuits are made up from a number of simpler circuits that the author deals with individually. Also included are several special interest circuits such as cars windshield wiper delay unit, a darkroom timer, metronome, etc.

BP88—How To Use Op-Amps \$5.99. Written as a designer's guide covering many operational amplifiers, serving both as a source book of circuits and a reference book for design calculations. There are chapters on Meet the Operational Amplifier, Basic Circuits, Oscillators, Audio Circuits, Filters, Miscellaneous Circuits, Common Op Amps, Power Supplies and Construction Notes and Fault Finding.

BP76—Power Supply Projects \$3.99. Presents a number of power-supply designs including simplified unbiased types, fixed voltage-regulated types and variable voltage stabilized designs. All are low-voltage types intended for use with semiconductor circuits. Apart from presenting a variety of designs that will satisfy most applications, the data in this book should help the reader to design his own power supplies. An essential addition to the experimenters electronics library.

ELECTRONIC TECHNOLOGY TODAY INC.
P.O. BOX 240, Massapequa, NY 11762-0240

Name _____

Address _____

City _____ State _____ Zip _____

NSW2 Allow 6-8 weeks for delivery

**SHIPPING CHARGES IN
USA AND CANADA**

\$0.01 to \$5.00.....	\$2.00
\$5.01 to \$10.00.....	\$3.00
\$10.01 to \$20.00.....	\$4.00
\$20.01 to \$30.00.....	\$5.00
\$30.01 to \$40.00.....	\$6.00
\$40.01 to \$50.00.....	\$7.00

\$50.01 and above.....\$8.50

**SORRY No orders accepted
outside of USA & Canada**

No. of Books Ordered

Total price of books\$
Shipping (see chart)\$
Subtotal\$
Sales Tax (NYS only)\$
Amount Enclosed\$

All payments must be in U.S. funds!

NEW LITERATURE

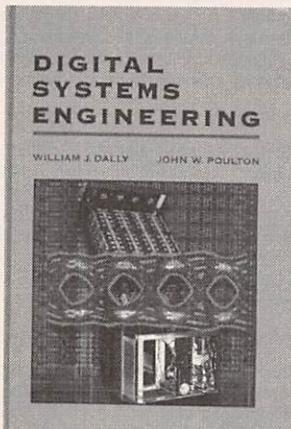
(continued from page 29)

digital and analog oscilloscopes and accessories, hand-held digital and clamp-on multimeters and accessories, component testers, and specimen analyzers. Specifications and ordering and pricing information are presented with each product.

Digital Systems Engineering

by William J. Dally and John W. Poulton
Cambridge University Press
40 W. 20th Street
New York, NY 10011-4211
Tel: 800-872-7423
Web: www.cup.org
\$54.95

Have you always wanted to know what makes some computers fast and others slow? Why do some digital systems operate reliably for years while others fail mysteriously every few hours? The answers to these questions of speed, reliability, and power are all determined by the system-level electrical design of a digital system.



CIRCLE 345 ON FREE INFORMATION CARD

Combining a thorough discussion of the fundamental principles in each area with real-world examples of circuits and methods, the book presents a comprehensive treatment of these topics.

BooksNow

To order books in this magazine or, any book in print. Please call anytime day or night: (800) BOOKS-NOW (266-5766) or (801) 261-1187 ask for ext. 1454 or visit on the web at <http://www.BooksNow.com/electronic-news.htm>. Free catalogs are not available.

Designed for both undergraduates and practicing digital designers, the book describes techniques, once only used in super-computers, that are now essential to the correct and efficient operation of any type of digital system.

TV Video Systems for the Hobbyist & Technician

by L.W. Pena and Brent A. Pena
Prompt Publications

Howard W. Sams & Company
2467 Waterfront Parkway, East Drive
Indianapolis, IN 46214-2041
Tel: 800-428-7267
Fax: 800-552-3910
Web: www.hwsams.com

\$14.95

CIRCLE 346 ON FREE INFORMATION CARD

Covering standard hard-wired cable, large-dish satellite systems, wireless cable, and digital satellite systems, this book explains the different systems, how they are installed, their advantages and disadvantages, and how to troubleshoot problems. It was written for the hobbyist, technician, and do-it-yourselfer who likes to understand how things work, as well as to inform readers about the choices available to receive TV signals.

There are easy-to-understand explanations of installations and connections, along with drawings and illustrations to guide and reinforce the subjects discussed. The nine chapters cover TV video systems, typical system components, apartment installations, home installations, troubleshooting tips, and more.

1999 Test and Measurement Product Guide

from Tucker Electronics
P.O. Box 551419
Dallas, TX 75355-1419
Tel: 800-527-7642 or 214-348-8800
Fax: 214-348-0367
Web: www.tucker.com
Free

This catalog is a comprehensive guide for purchasing reconditioned equipment. It features 200 pages of new and reconditioned test and measurement instruments from Hewlett-Packard, Tektronix, Fluke, Anritsu, Elgar, IFR, Lambda, Marconi, Sorenson, Wavetek, Yokogawa, and hun-



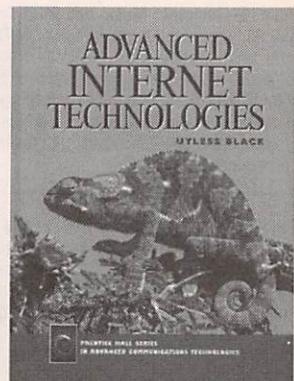
CIRCLE 347 ON FREE INFORMATION CARD

dreds of other leading manufacturers.

Among the new products are Yokogawa oscilloscope recorders and X-Y plotters, Huntron 4000 and 2500 component testers, Pomona oscilloscope probes, and FW Bell gaussmeters and milliammeters. Reconditioned products include Anritsu synthesized signal generators, Wiltron 6669A/03 programmable sweep generator, and Motorola R2008D communications system analyzer.

Advanced Internet Technologies

by Ulyss Black
Prentice Hall
One Lake Street
Upper Saddle River, NJ 07458
Tel: 800-282-0693
Web: www.phptr.com
\$49.99



CIRCLE 348 ON FREE INFORMATION CARD

This book introduces advanced Internet technology and the challenges of Internet communications. It covers the Internet's architecture, protocols, and traffic characteristics, and reviews the key issues involved in transforming the Internet from its data-only roots to a

true multi-service network that can handle voice, video, and multimedia with comparable quality and reliability.

Every key IP protocol is covered, including voice-over IP, MPEG-2 and the H.32x series for multimedia applications, layer 3 switching, IPv6, IP multicasting protocols and systems, and multi-service protocols such as RSVP, RTP, and RTCP. There is also detailed coverage of routing, route discovery, and traffic integrity operations, as well as state-of-the-art techniques for minimizing packet delay, and a detailed discussion of Mobile IP.

LFE/api by Triplet Catalog

from Triplet Corporation

One Triplet Drive

Bluffton, OH 45817

Tel: 800-TRIPPLETT or 419-358-5015

Fax: 419-358-7956

Web: www.triplett.com.

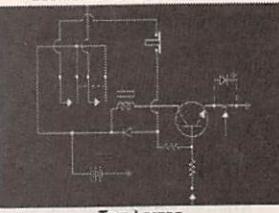
Free

CIRCLE 349 ON FREE INFORMATION CARD

This 16-page full-color catalog features optical, solid-state, locking-coil and magnetic-contact meter-relay controllers. It also contains analog panel meters including models with removable scales, edgewise meters, and ruggedized-sealed meters, as well as programmable digital panel meters. Complete specifications are given for each product line.

MORE BENCH-TESTED CIRCUITS

Innovative Designs for Surveillance and Countersurveillance Technicians



Tom Larsen

CIRCLE 350 ON FREE INFORMATION CARD

inexpensive, undetectable phone taps.

The author shows readers how to use off-the-shelf components to remotely turn a bug or a telephone tap on or off. Also included are some clever, low-power-drain circuits great for marking hidden caches or rendezvous points. Each circuit has a detailed schematic illustrating why and how it works.

Mobile Robots: Inspiration to Implementation, 2nd Edition

by Joseph L. Jones, Bruce A. Seiger and

Anita M. Flynn

A. K. Peters, Ltd.

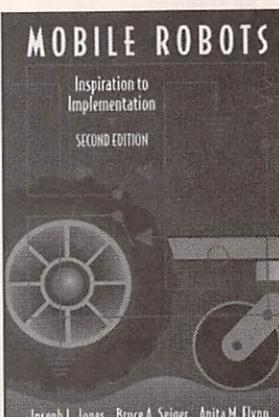
63 South Avenue

Natick, MA 01760

Tel: 508-655-9933

Fax: 508-655-5847

\$32



CIRCLE 351 ON FREE INFORMATION CARD

Robotics has made quantum leaps since the first edition of this book was published. This edition keeps pace with the ever-growing and rapidly expanding field of robotics. Using photographs, illustrations, and informative text, this edition guides readers through the step-

TECH MUSINGS

(continued from page 91)

One strange and wondrous book is David Lindsay's *Patent Files*. More on that is up at www.tinaja.com/amlink01.html.

But remember, for most individuals and smaller scale startups most of the time, any involvement with patents is virtually certain to end up as a monumen-tally dumb waste of time, energy, money, and sanity. Find out why in my *Case Against Patents* package, available per my nearby Synergetics ad.

The latest surplus additions to my www.tinaja.com/barg01.html include a few 16-millimeter aerial-gun movie cameras that are superbly rugged and fast, besides being a collectible. Also some precision film platen robotics.

Detailed and custom solutions for most any tech question can be gotten at my www.tinaja.com/info01, while longer term consulting can be found at www.tinaja.com/consul01.html.

As usual, most of these mentioned companies are in the Names And Numbers or in the Some EIS Resources sidebars. And a no-charge US voice helpline remains available per the nearby box. But do note catalogs are no longer mailed. Instead, you download them online at www.tinaja.com/synlib01.html or at www.tinaja.com/barg01.html. Similarly, all written help requests should include your e-mail address if you expect a personal answer.

EN

by-step process of constructing two robots—the TuteBot and the Rug Warrior.

Among the additions for this edition are a number of projects for the Rug Warrior, examples of robot projects and products by commercial and research groups, and heuristics and advice about robot design. The appendices have been revised and updated, and an appendix on robot contests has been added, as has information on programs and activities for robot enthusiasts.

EN

BooksNow

To order books in this magazine or, any book in print. Please call anytime day or night: (800) BOOKS-NOW (266-5766) or (801) 261-1187 ask for ext. 1454 or visit on the web at <http://www.BooksNow.com/electronicsnow.htm>.

Free catalogs are not available.

ADVERTISING INDEX

Electronics Now does not assume any responsibility for errors that may appear in the index below.

Free Information Number	Page	Free Information Number	Page
— Abacom Technology	67	— KNS Instruments	68
— ABC Electronics	68	— Lynxmotion	63
— AES	60	— M2L Electronics	71
213 Alfa Electronics	67	327 MCM Electronics	CV3
214 All Electronics	79	251 Mendelson Electronics Surplus	75
— Allison Technology	56	306 Merrimack Valley Systems	60
— Amazon Electronics	71	133 MicroCode Engineering	CV2
— Andromeda Research	63	— microEngineering Labs	73
— Arrow Technologies	54	— Midwest Laser Products	56
— Bsoft Software, Inc.	64	— Modern Electronics	74
322 C&S Sales, Inc.	52	— Mondo-tronics Inc.	73
— Cable USA	76	318 Mouser Electronics	54
332 Circuit Specialists	69	— MSC Electronics	71
— CLAGGK, Inc.	15	— Netcom	57
— Cleveland Inst. of Electronics	33	— NovaSoft	6
— Command Productions	50	334 OWI	49
— Computer Monitor Maintenance	73	— PC Boards	57
— Connecticut MicroComputer	67	— Pioneer Hill Software	62
— Custom Computers Service	63	222 Polaris Industries	58
234 Dalbani	65	315 Prairie Digital	57
— Decade Engineering	70	264 Print (Pace)	72
— EDE - Spy Outlet	71	266 Ramsey Electronics	66
— Electronic Tech. Today	24, 30, 93	283 Resources Unlimited	55
— Emac Inc.	64	— Saelig Co. LLC	63
— Engineering Express	70	— Securetek	70
— Fair Radio	56	— Sil Walker	68
335 Foley-Belsaw	59	— Square 1 Electronics	50
— General Device Instruments	62	— Super Circuits	75
— Glendale Software	62	— Tech Systems	68
— Grantham Col. of Engineering	10	— Tech-Specialties	70
329 Graymark International	51	— Techniks	70
— Home Automation	63	— Technological Arts	76
331 Howard Electronics	77	312 Telulex	51
— Howard Electronics	54	333 Test Equipment Depot	76
— ICS	75	217 Test Equipment Sales	74
— Information Unlimited	78	275 Timeline	64
— Intec Automation	70	— Unbound	50
138 Interactive Image Technologies CV4		— U.S. Cyberlab	60
— Intronics, Inc.	62	282 Velleman	81
319 IVEX Design	61	310 Visitect Inc.	78
— J&M Microtek, Inc.	71	— Weeder Technologies	82
— J-Tron Inc.	70	— World Star Technologies	70
— James Electronics	75	— Worldwyde	70, 71

ADVERTISING SALES OFFICES

Gernsback Publications, Inc.
500 Bi-County Blvd.
Farmingdale, NY 11735-3931

Tel. 516-293-3000
Fax: 516-293-3115

Larry Steckler
Publisher (ext. 201)
e-mail: advertising@gernsback.com

Adria Coren
Vice-President (ext. 208)

Ken Coren
Vice-President (ext. 267)

Christina Estrada
Assistant to the Publisher (ext. 209)

Marie Falcon
Advertising Director (ext. 206)

Adria Coren
Credit Manager (ext. 208)

For Advertising ONLY

EAST/SOUTHEAST

Megan Mitchell
9072 Lawton Pine Avenue
Las Vegas, NV 89129-7044
Tel. 702-240-0184
Fax: 702-838-6924
email: mmitchell@gernsback.com

MIDWEST/Texas/Arkansas/Oklahoma

Ralph Bergen
One Northfield Plaza, Suite 300
Northfield, IL 60093-1214
Tel. 847-559-0555
Fax: 847-559-0562
email: bergenr@aol.com

PACIFIC COAST

Anita Bartman
Hutch Looney & Associates, Inc.
6310 San Vicente Blvd., Suite 360
Los Angeles, CA 90048-5426
Tel. 323-931-3444 (ext. 227)
Fax: 323-931-7309
email: anita@hlooney.com

Electronic Shopper

Joe Shere
National Representative
P.O. Box 169
Idyllwild, CA 92549-0169
Tel. 909-659-9743
Fax: 909-659-2469
email: joe@greencafe.com

Megan Mitchell

National Representative
9072 Lawton Pine Avenue
Las Vegas, NV 89129-7044
Tel. 702-240-0184
Fax: 702-838-6924
email: mmitchell@gernsback.com

Customer Service

1-800-999-7139
7:00 AM - 6:00 PM M-F MST

Reader Service Card

MAIL-FAX OR E-MAIL YOUR REQUEST

Now you have 3 ways to request free information on products and services featured in this issue

To insure a prompt reply, please furnish all requested information

To Receive
Information on
Products and
Services in
This Issue

Circle the numbers corresponding to the advertised products or editorial items that interest you.

Mail Card

or Fax To: (413) 637-4343
or E-Mail your request to:
BERKCOMP@AOL.COM.

For E-Mail users,
your subject is
Electronics Now 7/99
Format your message:

- Name and Address information
- Telephone and Fax numbers
- Requested item numbers separated by commas
- Responses to survey questions separated by dashes or slashes

NOTE: Submit all Free Information requests by **EITHER** Fax, mail, or E-Mail
DUPLICATE REQUESTS WILL BE DISCARDED. Use

for Free Information only.
Address all editorial inquiries to Editor, Electronics Now, 500 Bi-County Blvd., Farmingdale, NY 11735-3931

BUSINESS PROFESSIONAL FREE INFORMATION CARD

Electronics NOW®

Name _____ Title _____
Company _____
Dept. MS _____
Daytime Business Phone _____
Company Address _____
City _____ State _____ Zip +4 _____
E-Mail Address _____

Unclear or incomplete mailing info will prevent our processing this request.

4DCG0

31 60 89 118 147 176 205 234 263 292 321 350
32 61 90 119 148 177 206 235 264 293 322 351
33 62 91 120 149 178 207 236 265 294 323 352
34 63 92 121 150 179 208 237 266 295 324 353
35 64 93 122 151 180 209 238 267 296 325 354
36 65 94 123 152 181 210 239 268 297 326 355
37 66 95 124 153 182 211 240 269 298 327 356
38 67 96 125 154 183 212 241 270 299 328 357
39 68 97 126 155 184 213 242 271 300 329 358
40 69 98 127 156 185 214 243 272 301 330 359
41 70 99 128 157 186 215 244 273 302 331 360
42 71 100 129 158 187 216 245 274 303 332 361
14 43 72 101 130 159 188 217 246 275 304 333 362
15 44 73 102 131 160 189 218 247 276 305 334 363
16 45 74 103 132 161 190 219 248 277 306 335 364
17 46 75 104 133 162 191 220 249 278 307 336 365
18 47 76 105 134 163 192 221 250 279 308 337 366
19 48 77 106 135 164 193 222 251 280 309 338 367
20 49 78 107 136 165 194 223 252 281 310 339 368
21 50 79 108 137 166 195 224 253 282 311 340 369
22 51 80 109 138 167 196 225 254 283 312 341 370
23 52 81 110 139 168 197 226 255 284 313 342 371
24 53 82 111 140 169 198 227 256 285 314 343 372
25 54 83 112 141 170 199 228 257 286 315 344 373
26 55 84 113 142 171 200 229 258 287 316 345 374
27 56 85 114 143 172 201 230 259 288 317 346 375
28 57 86 115 144 173 202 231 260 289 318 347 376
29 58 87 116 145 174 203 232 261 290 319 348 377
30 59 88 117 146 175 204 233 262 291 320 349 378

Please Respond by: September 30, 1999 Allow 6-8 weeks for delivery of first issue

BUSINESS PROFESSIONAL FREE INFORMATION CARD

Electronics NOW®

Name _____ Title _____
Company _____
Dept. MS _____
Daytime Business Phone _____
Company Address _____
City _____ State _____ Zip +4 _____
E-Mail Address _____

4DCG0

31 60 89 118 147 176 205 234 263 292 321 350
32 61 90 119 148 177 206 235 264 293 322 351
33 62 91 120 149 178 207 236 265 294 323 352
34 63 92 121 150 179 208 237 266 295 324 353
35 64 93 122 151 180 209 238 267 296 325 354
36 65 94 123 152 181 210 239 268 297 326 355
37 66 95 124 153 182 211 240 269 298 327 356
38 67 96 125 154 183 212 241 270 299 328 357
39 68 97 126 155 184 213 242 271 300 329 358
40 69 98 127 156 185 214 243 272 301 330 359
41 70 99 128 157 186 215 244 273 302 331 360
42 71 100 129 158 187 216 245 274 303 332 361
14 43 72 101 130 159 188 217 246 275 304 333 362
15 44 73 102 131 160 189 218 247 276 305 334 363
16 45 74 103 132 161 190 219 248 277 306 335 364
17 46 75 104 133 162 191 220 249 278 307 336 365
18 47 76 105 134 163 192 221 250 279 308 337 366
19 48 77 106 135 164 193 222 251 280 309 338 367
20 49 78 107 136 165 194 223 252 281 310 339 368
21 50 79 108 137 166 195 224 253 282 311 340 369
22 51 80 109 138 167 196 225 254 283 312 341 370
23 52 81 110 139 168 197 226 255 284 313 342 371
24 53 82 111 140 169 198 227 256 285 314 343 372
25 54 83 112 141 170 199 228 257 286 315 344 373
26 55 84 113 142 171 200 229 258 287 316 345 374
27 56 85 114 143 172 201 230 259 288 317 346 375
28 57 86 115 144 173 202 231 260 289 318 347 376
29 58 87 116 145 174 203 232 261 290 319 348 377
30 59 88 117 146 175 204 233 262 291 320 349 378

Please Respond by: September 30, 1999 Allow 6-8 weeks for delivery of first issue

**To Order a New Subscription or
To Renew an Existing Subscription
Call 1-800-999-7139**

.20¢ POSTAGE
REQUIRED IN
U.S.A.

Electronics
NOW®

**READER SERVICE MANAGEMENT DEPT.
P.O. BOX 5192
PITTSFIELD, MA 01203-9989**

.20¢ POSTAGE
REQUIRED IN
U.S.A.

Electronics
NOW®

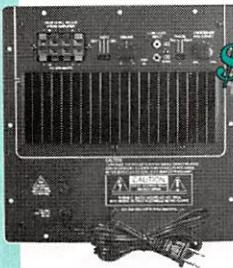
**READER SERVICE MANAGEMENT DEPT.
P.O. BOX 5192
PITTSFIELD, MA 01203-9989**

MCM ELECTRONICS®

Prices effective June 3, 1999
through July 30, 1999

The Source For All Of Your
Electronics Needs

When ordering, please provide this code: ► SOURCE CODE: ENS60



ONLY
\$99.95

Order #50-6265

**100W
Subwoofer
Amplifier
Module**

Ideal for anyone interested in making their own powerful subwoofer. Internally, this amplifier isolates, then sums the left and right inputs to give a single mono channel with 100W RMS output @ 4ohm, 85W RMS @ 8ohm. • Speaker level inputs • Satellite outputs • Line level inputs • Auto turn-on • 12dB B continuously variable 60Hz~160Hz crossover • Adjustable level control • 0°/180° phase selector • Fully sealed rear housing • Requires 8½" square opening • Call for quantity pricing



Order #82-835

ONLY
\$99.95

**DEFENDER
SECURITY
CCD Camera**

½" format black and white CCD camera features built-in iris and operates in subdued light to 0.3 lux. Includes 12VDC, 150mA adaptor, NTSC composite video output via BNC connector. Lens not included. Regular price \$129.00

Lenses

Viewing

Order #	Description	Angle	Mount	(ea.)
82-870	4mm	101°	CS	\$59.95
82-875	8mm	40°	C	59.95
82-880	16mm	21°	C	59.95



**FREE
Catalog**

1-800-543-4330

www.mcmelectronics.com

Hours: M-F 7 a.m.-9 p.m., Sat. 9 a.m.-6 p.m., EST.



ONLY
\$14.95

Order #29-1335

CSB
BATTERY

Sealed Lead Acid Battery

12 volt, 4.5 amp/hour battery is ideal for security and other power backup applications. 0.25" tabs accept standard quick-disconnects. Dimensions 3½" x 2¾" x 4". Regular price \$26.95



ONLY
\$39.95

Order #72-4025

**TENMA®
DMM W/Logic
Function**

3½ digit DMM measures AC/DC voltage from 200mV~600V, resistance to 2000Mohm, capacitance to 20pF, transistor h_{FE} gain and audible continuity test. Requires 9V battery (#290-080) not included. Dimensions: 2¾" (W) x 5¾" (H) x 1¾" (D). Regular price \$65.95.



Order #32-4425

Remote Control A/B Switch

Remote controlled RF switch allows selection from two sources for output to TV or VCR, via infrared remote. Frequency range: 5MHz~8900MHz. "F" type in/out connections. Remote requires two "AA" batteries not included (#290-070). Regular price \$25.75

**Same Day
Shipping!**

In stock orders
received by 5:00 p.m.
(YOUR TIME), are
shipped the same day.



MCM ELECTRONICS®

650 CONGRESS PARK DR.
CENTERVILLE, OH 45459

A PREMIER FARNELL Company

SOURCE CODE: ENS60

For over 20 years, MCM has been the leading supplier to the electronics service industry. Huge inventory, rapid delivery and competitive prices have made MCM the choice for:

- Hobbyists
- Service Technicians
- Educators
- Installers

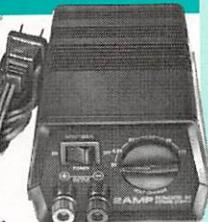
Discover the MCM difference, call today for your free catalog.

ONLY
\$9.95

Order #28-2200

**Multi-Voltage
Power Supply**

Fully regulated supply provides up to two amps, at the following selectable voltages: • 3 • 4½ • 6V • 7½V • 9V • 12V. Regular price \$16.95.



As Low As
\$5.99

**Pre-Assembled
Circuit Modules**

Ideal for repairing old equipment, prototype work or your latest project. These well constructed PC boards are fully assembled, tested and ready to use. Supplied with application instructions and technical specifications. All operate from a single 12VDC source. Call your MCM Sales Representative for more information on over 120 available modules.

Order #	Description	Reg.	Sale
28-4795	1W audio amplifier	\$7.49	\$5.99
28-4796	5W audio amplifier	13.95	11.15
28-4800	5W x 2 stereo amplifier	24.95	19.96
28-4801	15W x 2 stereo amplifier	39.95	31.96
28-4851	88-108MHz FM transmitter	24.95	19.96
28-4785	2 digit LED counter	14.95	11.96
28-5115	Flip-flop relay	14.95	11.96
28-4825	VOX relay	17.95	14.36
28-4815	Electric guitar preamplifier	8.95	7.16

Introductory
price
\$61.50

Order #60-9490

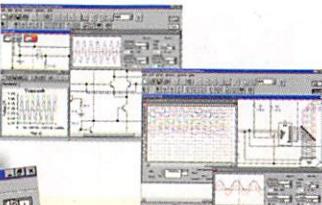
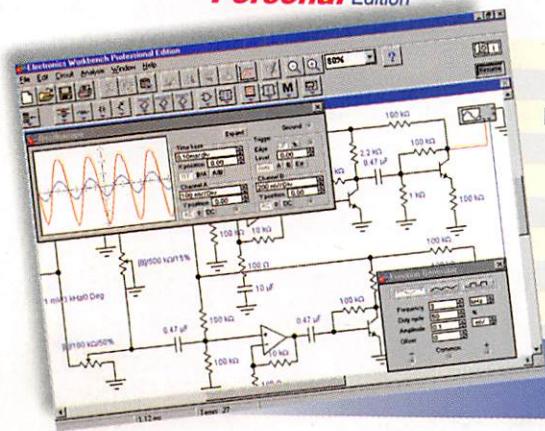
**15VDC, 350mA
Solar "Power Supply"**

Intended to maintain car batteries when vehicle is parked for extended periods of time, this solar panel generates 350mA @ 15VDC in full sunlight. Completely weatherproof design is UV/shock/hail resistant. Dimensions: 12" (L) x 12" (W) x 1" (D). Regular price \$74.95.



THE WORLD'S MOST POPULAR
DESIGN TOOL CHOSEN BY OVER
100,000 USERS!

Electronics
Workbench
Personal Edition



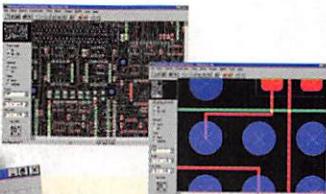
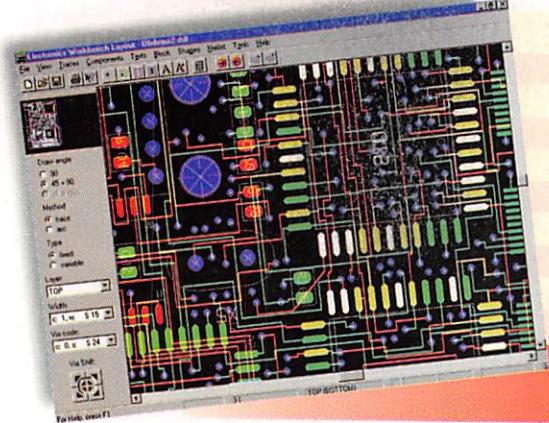
TRUE MIXED ANALOG/DIGITAL
FULLY INTERACTIVE SIMULATION
PRO SCHEMATIC EDITOR
6 VIRTUAL INSTRUMENTS
ON-SCREEN GRAPHS
OVER 4,000 MODELS
8 POWERFUL ANALYSES
FREE TECHNICAL SUPPORT

\$299

Full-featured schematic capture
and SPICE circuit simulation!

The world's most popular circuit design tool that sets the standard for powerful, insightful SPICE simulation. Create professional looking schematics and then with the flick of a switch, display simulated waveforms live on a suite of virtual instruments. Includes 15 powerful analyses and a library of over 4,000 robust component models.

Electronics
Workbench Layout
Personal Edition



AUTOROUTING
REROUTE WHILE MOVE
32 ROUTING LAYERS
50" X 50" BOARD SIZE
OVER 3,500 LIBRARY SHAPES
EXTENSIVE OUTPUT
REAL TIME DESIGN RULE CHECK
DENSITY HISTOGRAMS
FREE TECHNICAL SUPPORT

\$299

Power-packed PCB layout with
autorouting and real-time DRC!

EWB Layout is a powerful board layout package for producing high-quality, multi-layer printed circuit boards. Offering tight integration with our schematic capture program, EWB Layout is the best way to quickly produce well-designed boards.

CALL FOR INFORMATION
AND PRICING ON OUR
PROFESSIONAL EDITION.

800.263.5552

For a free demo, visit our website at www.electronicsworkbench.com

BUY BOTH AND SAVE! ~~\$598~~ \$548

30-DAY MONEY-BACK GUARANTEE

Fax: 416-977-1818

E-mail: ewb@interactiv.com

